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Managing Director

CHARLES H. BURDER
Editor

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MACHINERY

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[p. 173]H

Abstracts of Principal Articles

The Production of Components for Lambretta Motor Scooters P. 176

This second article describing the methods employed at the Innocenti works in Milan, Italy, is concerned with the production of finned cylinders for the 150-c.c. motor scooter. The castings are made in a foundry specially laid down for the purpose, in which shell moulds and cores are employed exclusively. Two automatic shell mould making machines are installed, and are fitted with patterns designed to produce one complete mould per cycle. Each mould contains cavities for two castings. Shell cores are also made on automatic machines, and their diameters can be varied to provide castings which can be machined with bore sizes suitable for 125- and 150-c.c. cylinders. After being closed with adhesive, the moulds are placed vertically in boxes, and backed up with sand. Rough machining to remove risers and other excess material is carried out in the foundry, so that swarf and scrap transportation problems are reduced, and the castings are hung on a conveyor for transport to the machine shop. Preliminary operations, including boring, turning and facing the spigot, and drilling the holding-down stud holes, are carried out on a multi-spindle vertical automatic, and the intake face and exhaust stub are then face-milled, and turned and faced, respectively, on a special machine. Drilling and tapping of the intake face follows on another special machine, after which the exhaust stub is thread-milled, the transfer ports within the cylinder are chamfered, and the bore is finally honed to a tolerance of 0.019 mm. (MACHINERY, 92—24/1/58.)

Production Set-ups on Six-spindle Conomatic Machines P. 188

When machining a striking pin lever from bar stock of special section, a slot is produced by a milling attachment. Slight angular float is permitted in the drive, so that final location of the cutter in relation to the work is ensured by radiused pads which engage flat sides on the bar stock. In the production of a V-grooved sleeve, on which certain surfaces must be accurately concentric and have a good finish, an undercut is formed by a tool mounted at an angle on the main slide and operated from the cross-slide. A third set-up incorporates an automatic loading arrangement for spherical-ended tie rods. (MACHINERY, 92—24/1/58.)

Production of Stainless Steel Collector Rings for Exhaust Gas Thermocouples P. 192

Half-circles are first formed from tubing and the ends are expanded to receive ferrules which are silver soldered in position. Holes are then cut in the tubing with an end mill, to receive outlet connections, which are secured by silver soldering. The thermocouple wires are bent to a circle and threaded through ceramic spacers. At the outlet positions, T-pieces are soldered to the wires to provide connections for pins. In assembly, considerable dexterity is required to ensure that the T-pieces are correctly positioned in relation to the outlets. (MACHINERY, 92—24/1/58.)

Operations on Perforated Drums and Housing for Dryers P. 195

Sheets which are to be formed into drums for laundry dryers are first perforated over two large areas, on a press which operates at 182 strokes per min. There are 86 punches in two staggered rows, and the sheet is advanced automatically after each stroke, 43 indexing movements being required for each perforated area. Subsequently, each sheet is notched, trimmed, pierced and formed, after which it is rolled to a generally cylindrical shape, and the ends are joined by spot welding. Cylindrical housings, after being rolled and seam welded, are flanged at both ends simultaneously. (MACHINERY, 92—24/1/58.)

Heavy Bending Operations P. 203

Steel blanks of 1½- by 5½-in. section are bent edgewise on a Pines machine to form blade beams for Caterpillar motor graders. The equipment employed for this operation is arranged to exert both vertical and horizontal clamping pressure on the work, and to limit the amount of thickening that takes place on the inside of the bend. Compensation is made for spring-back and a bend accuracy of $\pm \frac{1}{16}$ in. is maintained. Subsequently, a second bend, of large radius, is made in a plane at right angles to that of the first. (MACHINERY, 92—24/1/58.)

The Introduction of Numerically-controlled Machine Tools P. 205

A tape-controlled Kearney & Trecker profile milling machine has recently been installed by the Baltimore Division of the Martin Co., U.S.A. If such a machine is to be used to the best advantage considerable reorganization of existing methods and procedure may be necessary. In this instance, preparations, as here outlined, were begun 12 months before the delivery date for the machine. It is emphasized that, in preparing the information to be included on the punched tape, the planning engineer must provide a comprehensive operations schedule. Particular attention must be paid to the design of fixtures, clamps, and cutters, to ensure the necessary rigidity. For initial batch production, the various stages of an operation were separated by blank lengths of tape to facilitate any necessary corrections. (MACHINERY, 92—24/1/58.)

Use of Electric Clutches and Brakes to Safeguard Machines P. 207

With higher operational speeds and increased complexity of automatic movements, protection of machines from damage is assuming greater importance. Electrically-operated transmissions can afford such protection, and some typical applications include a high-speed indexing table, a Geneva drive for a piston ring assembly machine, and the drive to a dresser bar on a duplex disc grinding machine. (MACHINERY, 92—24/1/58.)

IN FORTHCOMING ISSUES

The production of V.D.F. standard lathes.

Automatic Production

At a time when deliberate and indiscriminate restriction of investment has once more become a part of Government "policy," the pattern for development of manufacturing methods in the metal working industries during the next decade is being rapidly established. Already, there is evidence to show that fully automatic production techniques are likely to be introduced sooner, and on a much wider scale, than seemed probable only a few years ago. It is also apparent that there has been a tendency to underrate the requirements for plant and equipment to enable components to be processed with the minimum of interruption and human intervention. In this connection, it is of interest to consider two examples that have recently been reported and are concerned with what may be regarded as opposite ends of the production scale.

As is well known, jig boring machines play a vital part not only in the tool-room but also in small-quantity precision manufacture. For many years, highly-developed measuring systems have been applied to such machines to enable the required standard of work accuracy to be achieved, and more recently, increasing attention has been directed to the provision of automatic positioning arrangements. Rapid and consistent table setting under the control of punched cards or tape is obviously an advantage, and on certain machines provision has also been made for automatic selection of the correct speed and feed for each operation stage on a particular tool or component. Hitherto, however, it has been necessary for an operator to be in attendance to change the tools, of which many may be required for a complex workpiece.

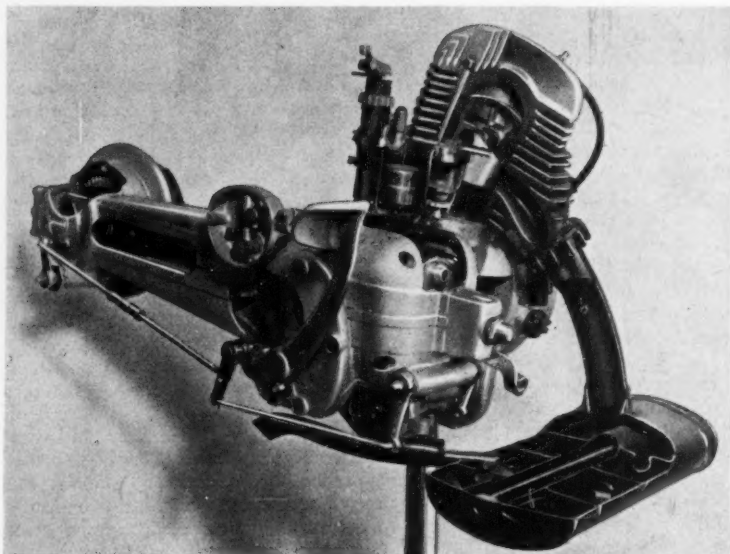
Obviously the next step was to provide for automatic tool changing and this is now said to have been successfully accomplished, at least in one instance. The tools required for a given series of operations are loaded into a circular holder supported by an arm which, in turn, is carried on a floor mounted pillar. Under tape control, the holder is indexed and advanced along the arm to bring a tool into position beneath the spindle. The tool, which has a threaded shank, is then gripped by pneumatically-operated jaws while the spindle descends, rotating slowly, so that the threaded socket is screwed on to the shank with a predetermined torque. For removing a tool this sequence is reversed.

Once automatic tool changing had been accomplished, it remained to provide for rapid approach and cutting depth control for tools that project for different distances from the spindle nose. As the spindle descends, the tool point interrupts a light beam set at a certain distance above the work surface and rapid traverse then continues until cutting is about to begin, when the specified feed rate is engaged. Vibration peculiar to the cutting operation is detected by a piezoelectric crystal at the moment when the tool contacts the work, and thereafter the depth of hole is measured by a shaft-digitizer, which is geared to the feed drive.

The other example relates to a simple component which is required in large quantities. It takes the form of an accurate plain ring, chamfered on both corners externally and internally and provided with internal gear teeth. Clearly this part presents no particular production problems, but the elaboration of equipment which has been found necessary to permit almost complete automation is of interest. Blanks for the gears are parted-off from tubing on multi-spindle automatics and heat treated. Subsequent operations provide for rough-grinding on both faces simultaneously; turning and chamfering two rings at a time; boring and chamfering, two at a time; internal broaching, three at a time; finish-grinding on both faces simultaneously; finish grinding the outside diameter; barrel finishing to remove burrs; and washing. Feedback control is employed on the grinding, turning and boring machines, and automatic loading and unloading arrangements have necessarily been provided at all the machining stages. In addition, to serve this simple line of machines, the following have been found necessary: a total length of 350 ft. of flexible chute for gravity transfer; 13 elevators; seven storage units with individual capacities ranging up to 2,000 parts; one combined elevating and storage unit; an automatic gauging station for checking blanks; separate automatic gauging units for turned and bored diameters and external and internal chamfers; work divider and blender units associated with the external diameter grinding machine; loading and unloading equipment for the barrel finishing installation; and a final gauging and classifying unit for segregating the gears into various thickness groups. The only operations performed manually throughout the cycle are the

(Continued on page 221)

The Production of Components For Lambretta Motor Scooters



*Some Interesting
Production Methods
Employed for the
Manufacture of
Cylinders in the
Innocenti Works,
Milan, Italy*

In an article published in *MACHINERY*, 92/60—10/1/58, reference was made to the large factory now occupied in the Lambrate district of Milan, Italy, by the Innocenti Company, and to some of the activities of the Mechanical Equipment and Motor Divisions. The latter Division is responsible for the production of Lambretta motor scooters at the rate of about 500 per shift, working for two shifts per day. Scooters are made in three sizes, with cylinder capacities of 125, 150 and 175 c.c., also an auto-cycle or mo-ped with a power unit of 49 c.c. capacity. Of the engines employed in these machines, the first two are very similar, and they incorporate many common components. The engines for the larger scooters and the auto-cycle have been newly designed, but somewhat similar methods are used for the manufacture of such basic parts as pistons, cylinders, and connecting rods. All the engines are of the air-cooled, 2-stroke type. They incorporate finned cast-iron cylinders, which are produced by similar methods, and in this article the manufacture of cylinders for the 125- and 150-c.c. units will be described. A 125-c.c. power unit, with the gearbox, clutch and final drive, as described in the previous article, and cut away so that the internal arrangement and details of the finned cylinder may be observed, is shown in the

heading illustration. The main difference between the cylinders for the 125- and the 150-c.c. engines is in the size of the bores, which have nominal diameters of 52 and 57 mm., respectively, and the castings are produced with different cores, of 45 and 52 mm. diameter.

The design of Lambretta 2-stroke engines follows conventional practice, and the cylinders are cast with inlet and exhaust gas passages. As may be seen from the examples of castings at various stages of production in Fig. 1, and from the drawing Fig. 8, which gives the main dimensions of the cylinder with the larger bore diameter, the mixture of petrol, oil and air enters the cylinder from the carburettor, which is secured to a flat face machined on one side of the casting. As the piston rises, mixture is drawn into the cylinder beneath it, and during the subsequent power stroke, this gas is compressed in the crankcase until the piston uncovers two transfer ports in opposite sides of the cylinder wall, at 90 deg. to the carburettor port and slightly higher up. These transfer ports communicate with the interior of the crankcase through passages, cast in the cylinder walls, which emerge outside the locating spigot. Apertures in the mounting face of the crankcase provide for passage of the gases upwards, and the arrangement of the

ports is such that efficient scavenging of the burnt gases takes place through the specially-designed exhaust port. This port is placed opposite that for the carburetter, and is level with the transfer ports, and it has a constantly-changing cross-section, which varies from approximately rectangular to circular, as shown in Fig. 8.

SHELL MOULD CASTING OF FINNED CYLINDERS

Shell moulding was adopted for the production of finned cylinders by Innocenti because of the advantages of dimensional accuracy, good surface finish (especially on the fins), elimination of misruns on thin sections (such as those at the edges of the thin fins), and the quality of the cast metal. Due to the uniform rate at which cooling takes place in a shell mould, a close-grained structure is obtained, and the rate of bore wear is less than for a cylinder cast in a conventional green sand mould. Until the company decided to produce their own finned cylinders, these components were purchased from an outside source, since there was no foundry at the Lambrate works. The finned cylinders are now produced in a foundry specially laid out for the purpose, in which the most efficient techniques are employed, semi-automatic equipment having been installed for the production of moulds and cores, closing, backing up, pouring, and knocking out. In addition, rough machining of the castings for the removal of runner bars and risers is carried out in the foundry, so that the unnecessary transport of material which is to be turned into swarf is avoided, and scrap is re-melted on the spot.

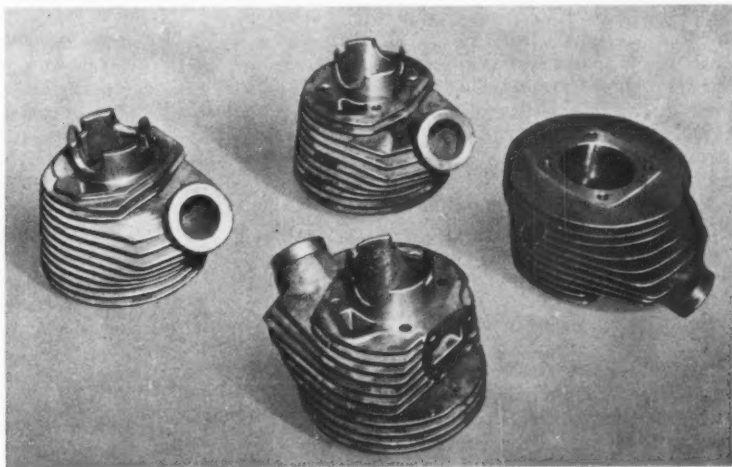
Details of the shell mould employed for the

production of a pair of cylinders may be seen in Fig. 2, which also shows a pair of shell cores and a spray of castings from a similar mould. The layout of the cavities, and the bottom-gating arrangement, follow conventional practice for such castings, the metal passing through a tapered down-gate, which is designed to serve also as a pouring cup, to a horizontal runner bar. From the ends of this bar, the metal enters each cavity through an annular runner, which surrounds the core print, and flows steadily upwards to fill the space between the cores and the fin grooves, finally entering the large riser cavity at the spigot end of the casting. The use of shell cores for such a casting ensures that the passages through which the gas passes into the cylinder are accurately shaped and positioned, and have smooth surfaces so that the flow is not impeded. A feature of the shell moulds for these cylinders is the provision made for closing, which is effected with a cold-setting resin adhesive, as will be described. For this purpose, shallow grooves are formed in the flat face of one mould half, seen at the left in Fig. 2, and corresponding projections on the face of the other half. The projections provide a large gluing area, and thus ensure extra strength of bonding, and the grooves, which are somewhat larger than the projections, accommodate any excess adhesive, so that the mould halves are not held apart at the joint by a layer of glue.

MOULD PRODUCTION

Shell moulds are made on two F.E. (Sutter) (Foundry Equipment, Ltd., Leighton Buzzard, Beds) S.P. 1,000 automatic cycle machines of the

Fig. 1. Four Cylinder Castings for the 150-c.c. Lambretta Scooter at Various Stages of Production. The Casting at the Left is in the Condition in which it is Despatched from the Foundry to the Machine Shop



type first described in MACHINERY, 82/593—27/3/53. Moulds measuring up to 20 by 30 in. can be produced on these machines, one of which is seen close up in Fig. 3, and each is fitted with a pattern plate designed to make the two half moulds, shown in Fig. 2, at each cycle. It may be recalled that this machine is of the single station type, with the pattern plate secured to a trunnion-mounted frame which incorporates an air-operated ejector-pin plate. The pattern plate frame is inverted by means of two air cylinders, acting through a roller chain and sprocket arrangement, and, for investment, the dump-box is raised

ing cooling will be common to both halves. Consequently, the joint faces remain in contact all over, and penetration by the liquid metal is prevented. As produced, the mould halves are joined along the edges which are at the top in Fig. 2. The flat faces surrounding the mould cavities are so shaped that consumption of resin-sand mixture is kept to a minimum, the corners of the pattern plate, and a triangular portion at the centre of each long side, being covered by projections extending from the inside edges of the dump-box. Baffles inside the dump-box direct the sand towards the centre of the plate, so that resin is not cured on

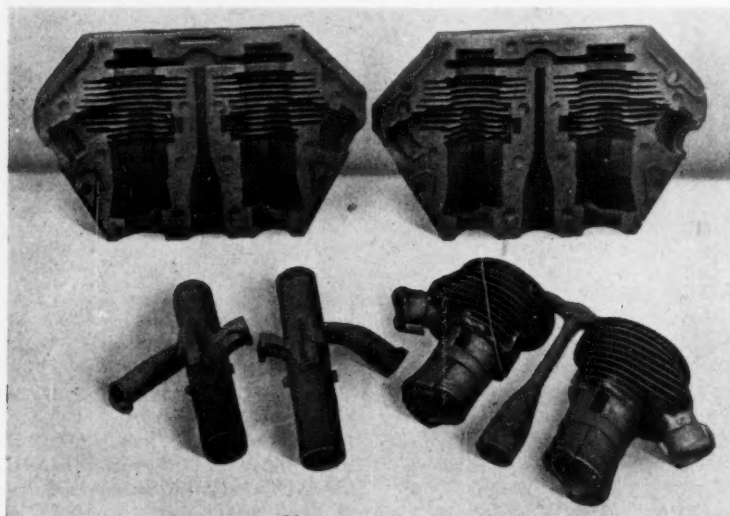


Fig. 2. A Pair of Shell Moulds, Two Cores and a Spray of Castings Made with Similar Moulds and Cores. Castings for the 125- and 150-c.c. Engines are Made in the Same Moulds but with Cores of Different Diameter

into contact with the frame, to which it is then fastened by air-operated clamps. After investment, the dump-box is returned to its original position beneath the frame, as seen at the lower right in Fig. 3, and the pattern plate is turned so that the invested surface is upwards. An electrically-heated oven is then moved forward over the pattern to complete the curing of the resin in the mixture, so that the sand grains forming the shell are securely bonded together. After the oven has been moved back, the ejector pins are raised to lift the shell from the pattern, as shown in Fig. 3, and the cycle is restarted.

The moulds are taken from the machine to the bench in the left background in Fig. 3, where they are broken into halves by the operator. These halves are then placed face to face, and clamped in four positions round the edges with C-clamps, so that any slight distortions of the mould faces dur-

ing cooling will be common to both halves. Consequently, the joint faces remain in contact all over, and penetration by the liquid metal is prevented. As produced, the mould halves are joined along the edges which are at the top in Fig. 2. The flat faces surrounding the mould cavities are so shaped that consumption of resin-sand mixture is kept to a minimum, the corners of the pattern plate, and a triangular portion at the centre of each long side, being covered by projections extending from the inside edges of the dump-box. Baffles inside the dump-box direct the sand towards the centre of the plate, so that resin is not cured on

the faces of the projections by heat transferred to them from the pattern plate. Both the bench employed for temporarily closing the moulds, and the mould-making machine, are fitted with vacuum extraction ducting and hoods to remove any dust or fumes resulting from the processes, and fluorescent strip lighting is installed inside the hood over the machine, which is situated near the centre of the building, away from the windows. The F.E. (Sutter) machine operates on an automatic cycle, which is initiated by depressing a push button after removing the completed mould. At the rear of the machine, there is a small belt conveyor which can be fed with resin-sand mixture from a vibratory hopper. The conveyor terminates above the position occupied by the dump-box, when the latter is lowered, and the conveyor and vibratory feeder are switched on automatically, for a controlled period, during each curing cycle,

Fig. 3. Removing a Completed Shell Mould of the Type Seen in Fig. 2, from the Automatic F.E. (Sutter) Machine. Economy in the Consumption of the Sand-resin Mixture is Achieved by Fitting Baffles to the Dump-box

to replace the resin-sand mixture consumed in producing one complete shell.

A mixture of a local Italian clay-free silica sand, with a grain size of about 65 A.F.S., and 5.5 per cent of phenol-formaldehyde resin, is employed for the moulds, and mixing is carried out in an automatic plant. Experiments have been made with sand pre-coated with resin, but, so far, it has not been adopted for moulds, because the advantages which it offers are not considered to be sufficient to justify the extra cost, except for the manufacture of cores. The mould-making cycle at present occupies about 4 min., mainly because no heaters are fitted beneath the patterns. The latter are of cast iron of high specific heat, and they do not absorb sufficient heat during the curing cycle to maintain them at the optimum temperature, especially as the resin-sand investment has good heat-insulating properties. For these reasons, it is necessary to include a pattern-heating period in the machine cycle, and this occupies about 1 min. Moreover, the cycle is prolonged slightly by the length of the investment period required to build up the specified shell thickness of $\frac{1}{16}$ to $\frac{1}{8}$ in. Pattern heaters are to be installed soon, however, and will undoubtedly enable the cycle time to be shortened considerably.

After the two half-moulds have cooled sufficiently to become stable, during a period of about two or



three machine cycles, the C-clamps are removed and the shells are placed on specially-designed platforms, suspended from a conveyor which passes close to the left-hand side of the bench. The half-mould with grooves in the face is placed with its two pairs of locating holes over dowels, which project upwards from the platform, and the mating half is laid on a framework alongside it. On this conveyor, the moulds travel to the closing station. At alternate positions, the conveyor carries hangers designed to carry cores, and it passes close to two

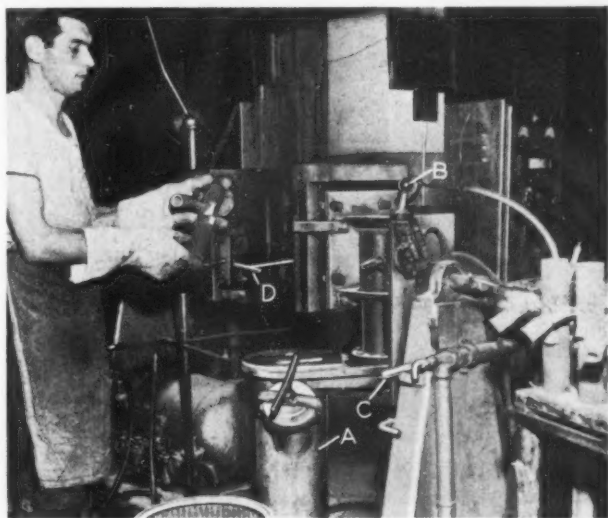


Fig. 4. Shell Cores are Produced on Automatic Machines in which the Pre-coated Sand is Blown Upwards into the Core-box Cavity. Sliding Members in Each Half-box Form the Transfer Port Projections

Shalco (Shallway International Corporation, 25 Black Dog Walk, Crawley, Sussex), automatic shell core-making machines, as seen in Fig. 4.

SHELL CORE MANUFACTURE

A description of the Shalco machine was published in *MACHINERY*, 86/608—18/3/55, and it may be recalled that there is a fixed and a moving platen, with vertical faces, the arrangement being somewhat similar to that of a die casting machine. The platens are electrically heated, under thermostatic control, and heat is conducted to the two halves of the core-box which are secured to them by clamps. An air cylinder actuates the moving platen. Sand, which is pre-coated by the Feslente process, enters the core-box through an opening at the under-side. Beneath this opening is the blowing chamber, A, Fig. 4, which has an orifice at the top to match that of the core-box, and is raised into the blowing position by an air cylinder. A gasket of heat insulating material surrounds the blowing chamber orifice, to prevent heat transfer from the core-box, and consequent curing of the resin and build-up of sand round the hole. In operation, the core-box halves are brought together by opening the air valve B, with the blowing chamber A in the raised position. Air is then admitted to the lower end of the chamber by way of the valve C and a large-bore flexible tube, so that the sand is blown upwards to fill the core-box cavity completely.

After sufficient time—usually about 10 to 15

sec.—has elapsed for a layer of the required thickness to form on the walls of the cavity, the air pressure is cut off, and the excess sand in the centre of the core falls back into the blowing chamber. A further period is then allowed, to complete the curing of the resin in the investment layer, before the box is opened and the finished core removed, as shown in Fig. 4. The shape of the cores made in this way can be seen more clearly in Fig. 2, from which it may be noted that each core has two projections for the formation of the transfer ports in the cylinder castings, through which the mixture passes from the crankcase to the space above the piston in the cylinder. The cavities between the cylindrical portion of the core and each projection are formed by retractable sliding members in each core-box half. These members are operated by means of T-handles, one of which is indicated at D in Fig. 4. Cavities in the opposing faces of the sliding members provide for the formation of the longer of the two other projections, on the left-hand side of the core which the operator is holding in Fig. 4, whereby the exhaust port is formed in the cylinder casting.

CLOSING, BACKING-UP AND POURING THE MOULDS

A view of one of the closing stations for the shell moulds is given in Fig. 5. Before they reach this point, both mould halves are cleaned by blowing out the cavities with compressed air, after which they are covered with special, thin, transparent

covers, in order to prevent the entry of any further dirt. These covers have been removed in Fig. 5, so that the moulds may be seen more clearly. The mould half at the left is located by means of its four positioning holes on the dowels mentioned previously, and, in preparation for closing, the two cores are set in position, as shown. Cores are taken from the adjacent hanger of the conveyor, which is obscured by the operator in Fig. 5, and after they have been placed in

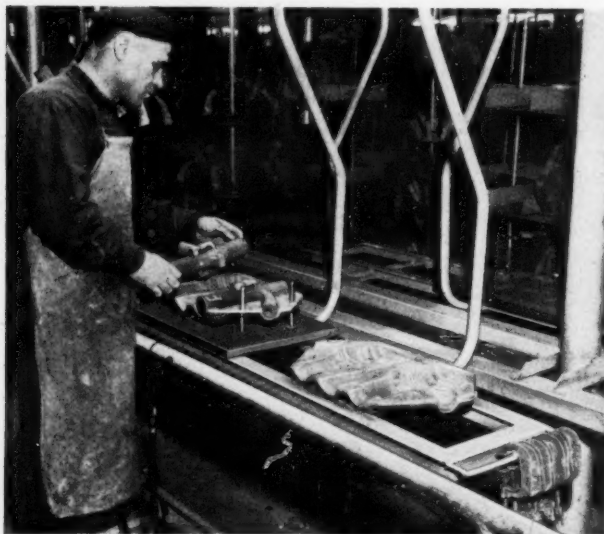


Fig. 5. At the Mould-closing Station, to which the Mould Shells are Carried on the Conveyor Shown, Cores Taken from Another Conveyor Hanger are First Placed in Position in the Left-hand Shell

Fig. 6. The Grooves in the Face of One Shell are Filled with a Cold-setting Resin Adhesive before the Other Half Shell is Placed in Position and Secured with C-clamps, which are Left in Position Until the Resin is Cured

the half-mould, the continuously-moving conveyor carries the hanger to the next operator, who applies ribbons of cold-setting resin adhesive, in the form of a thin paste, to the grooves provided in the face. The adhesive is applied with the aid of a flexible rubber bottle, of the type seen at E on the wire mesh shelf behind the position occupied by the carrier in Fig. 6, which shows the closing position for the moulds.

At this position, the transparent cover is removed from the uncured half-mould, which is then lifted, inverted, and placed in position above the cored half, where it is located by the same dowel pins. At the right-hand end of each carrier there is a rail on which is hung a total of nine C-clamps, and these are now applied to the edges of the mould, as seen in Fig. 6, to hold the mould faces in contact while the resin adhesive is cured. A core carrier may be seen on the extreme right in Fig. 6. From the closing station, the moulds are carried along convolutions on the conveyor, the passage of which occupies a period of

about 10 min. During this period, the resin adhesive sets, and moulds then reach the backing-up station, where the clamps are removed and returned to the rail of the carrier. Here, the moulds are placed vertically in specially-designed boxes, each of which holds four, and is suspended from an overhead conveyor by an arrangement similar to that employed for the carriers in Fig. 5. The pouring funnels of the moulds are closed with plastic caps, and the boxes are then filled with foundry sand to

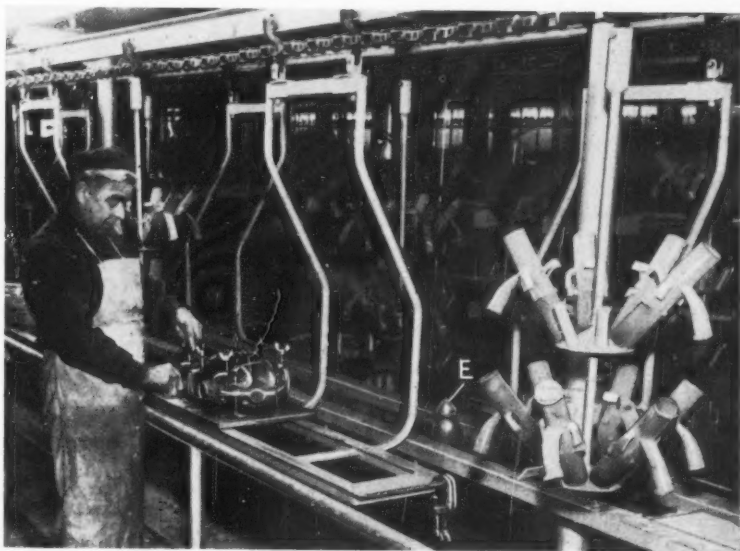


Fig. 7. From the Electric Furnace at the Left, Molten Cast Iron is Tapped into a Receiver which is then Employed to Replenish the Hand Ladles from which the Moulds on the Conveyor at the Right are Filled

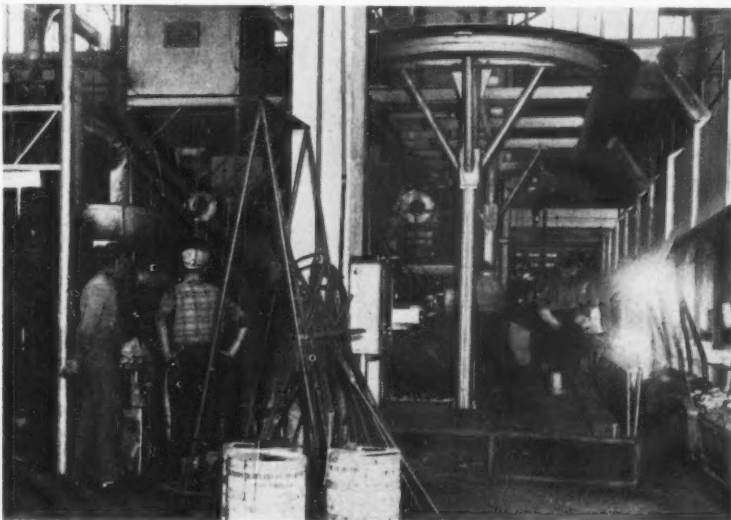
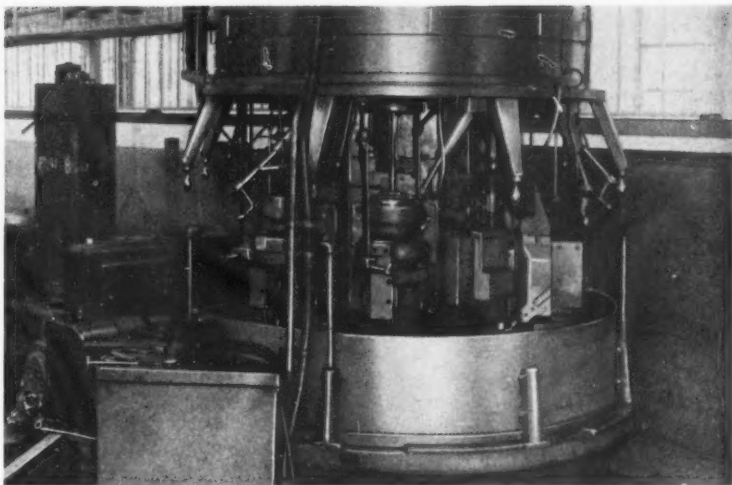


Fig. 9. The first Series of Operations on the Cylinder Castings is Carried Out on this Bullard Multi-Au-Matic 8-spindle Machine, on which Each Casting Makes Two Circuits



required are few in number, and involve a minimum of metal removal. The first operations are carried out on the Bullard (Buck & Hickman, Ltd.), 8-spindle Multi-Au-Matic vertical turning and boring machine shown in Fig. 9. These operations include roughing, semi-finishing, and finishing the bore, facing the ends, turning the spigot, and drilling the four 7.75 mm. diameter stud holes. The work is completed in two stages, each casting making two circuits of the machine, which is arranged for double-indexing. Initially, a casting is loaded with the spigot end downwards, and it is inverted for the second series of operations, for which it is transferred to the adjacent chuck.

A view of the loading positions on the machine is given in Fig. 10, where the chuck to which the castings are transferred from the conveyor is on the right. Loading is carried out with the aid of a setting gauge *F*, which ensures that the intake and exhaust ports will be at the correct heights relative to the spigot face of the finish-machined casting. The setting gauge has two fingers, one of which enters the intake and the other the exhaust port, and these fingers are spring-loaded outwards. Both fingers can be retracted simultaneously, by lifting the lower of the two cross-bars at the top of the gauge, and, then, they can be held in

the retracted position by the swinging slotted stirrup attached to the handle above, to facilitate removal of the gauge after loading has been completed.

With the setting gauge in position, and the two fingers engaged in the ports, the cylinder casting is placed in the three-jaw chuck shown, where it is located angularly by a spring-loaded plug which enters the exhaust stub. The cylinder is held at the correct height by the end of the setting gauge which rests on the chuck face, and the jaws are then closed to grip the fins on the outside edges. At the first machining station, the cylinder is rough bored and chamfered at the top end. The next



Fig. 10. Close-up View of the Two Loading Positions on the Bullard Machine. The Setting Gauge *F* is Employed at the Initial Loading Operation for Setting the Exhaust and Intake Ports at the Correct Height

station has two tools, which take a roughing and a finishing cut across the head face, and, at the fourth station, there is a multi-spindle head which is applied to drill the four 7.75-mm. diameter stud holes to a depth of 75 mm.

After a casting has made one circuit of the machine, it is transferred to the left-hand chuck in Fig. 10. In this chuck, it rests on its machined top face, between specially-shaped jaws which conform to the fin profiles, and is angularly located by two dowels in the partly-drilled stud holes. The chuck jaws are provided with thin projections which enter a space between two of the fins on the cylinder, and after they have been advanced inwards, the jaws are drawn downwards to clamp the casting. Knurled-head screws, one of which is held in a swinging bracket for convenience in loading, are then screwed inwards by hand to support the work against the pressure of the cutting tools. At the first machining station to which the casting is carried during its second circuit, the spigot end of the cylinder is rough bored, the spigot is faced to length, and the outside is semi-finish turned. Tools at the next station finish the bore, leaving about 0.0015 in. for removal at the final honing operation. These tools also turn the outside of the spigot to 62 (-0.060 , -0.134) mm., and finish the mounting face to a length of 91.5 (-0.00 , -0.22) mm. from the top face. At the final station, the four stud holes, which pass right through the casting, are completed. For these operations, a spindle speed of 320 r.p.m. is employed, with feed rates up to 0.025 in. per rev., and the cycle time for the completion of one casting is 1 min. 45 sec.

After the preliminary turning and boring opera-

tions, the castings pass to the special Oerlikon Italiana (Vaughan Associates, Ltd.), milling and turning machine, shown in Fig. 11. Here the casting is held with the exhaust stub in a horizontal position, so that it may conveniently be machined by tools on the spindle of the unit head at the right. The casting is loaded on an inclined expanding mandrel, angular location being provided by dowel pins which enter the stud holes. A C-washer is then inserted between the spigot face and a spring-loaded washer on a draw-bar, which passes up through the mandrel centre. This draw-bar is pulled down, to expand the mandrel and lightly clamp the casting, by an air cylinder within the fixture base, controlled by the valve at the lower left-hand side in Fig. 11. Arranged to operate on a fully automatic cycle, the machine is started by pressing one of the push-buttons on the panel at the right, and the tools then advance rapidly towards the work. Only the spindle of the right-hand head moves, and carries a cutter head with four tools which provide for turning the outside, facing the end, and chamfering the inner and outer edges of the exhaust stub, ready for the subsequent threading operation. A spindle speed of 450 r.p.m. is employed, and the feed rate is 0.005 in. per rev.

The left-hand unit head is mounted on guide-ways which are disposed at a compound angle, to suit the orientation of the exhaust stub in relation to the face of the intake port that it is required to machine. A right-angle milling adapter is fitted to the unit head, and it carries a cutter of approximately 2½ in. diameter, with five carbide-tipped teeth. The complete head is traversed to mill the intake port face with a feed of 0.020 in. per rev., and a spindle speed of 360 r.p.m. is used.

Drilling, chamfering and tapping of the three stud holes in the intake port face is next carried out on the machine in Fig. 12, which is installed near the milling and turning machine,

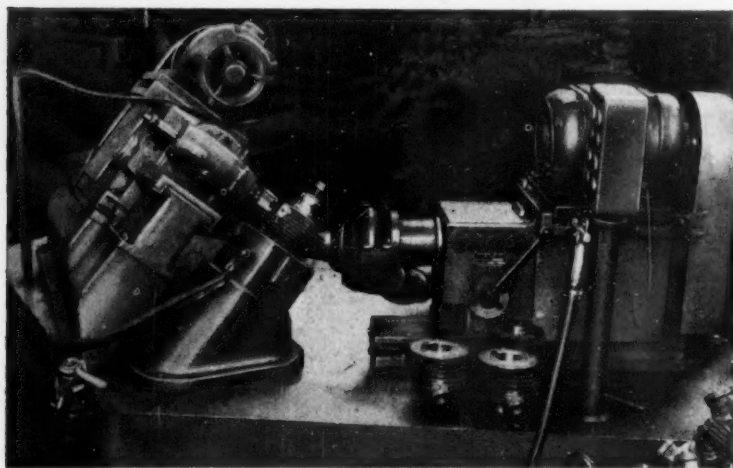


Fig. 11. On this Special Oerlikon Italiana Machine, the Exhaust Stub is Turned, Faced and Chamfered by the Head at the Right, and the Intake Port Face is Milled by the Other Head

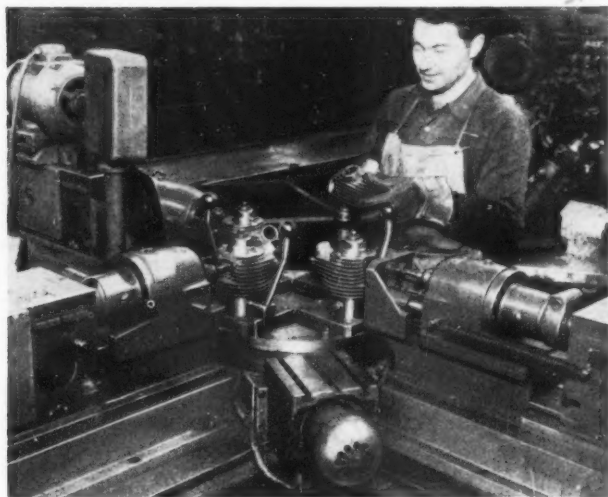


Fig. 12. Another Oerlikon Machine is Employed for Drilling, Chamfering, and Tapping the Three Stud Holes in the Intake Port Face for the Attachment of the Carburetter, and is Tended by the Same Operator as the Machine in Fig. 11

and is tended by the same operator. The castings are again loaded, in the inverted position, on to expanding mandrels, of which there are four on the 90-deg. indexing table, and are located by the stud holes. Expansion of the mandrel is effected by a cam, which is turned by the ball-handled lever at the base of each fixture, and the indexing drive is taken from the small motor seen at the centre in Fig. 12. A lever, on the operator's side of the machine, withdraws the table-locating pin downwards against spring pressure, in readiness for indexing. Towards the limit of its travel, after the pin has been fully withdrawn, the lever operates a micro-switch to complete a circuit to a relay, and the motor is switched on. When the table has been turned through nearly 90 deg., the motor is automatically switched off and the pin is then allowed to rise to locate the table in the new position. The

operator then presses a button to start the automatic machining cycle. First, three holes of 5-mm. diameter are drilled by the unit head at the right, and these holes are chamfered by the head at the left, when the table is next indexed. The head at the far side of the machine is equipped with three taps, of 6-mm. diameter by 1-mm. pitch, for the threading operation, and a micro-switch reverses the direction of spindle rotation when the threads have been cut to full depth.

INNOCENTI THREAD-MILLING MACHINE

A special Innocenti-built machine, illustrated in Fig. 13, is employed for milling the thread on the end of the exhaust stub to take the union nut whereby the exhaust pipe is secured to the cylinder. This thread, of 44 $(-0, +0.02)$ mm. diameter, has a pitch of 1.5 mm. and is 10 mm. long. The workhead of the machine, at the left in Fig. 13, has a hollow spindle, which carries a fixture for the casting. Projecting from an inclined face on this fixture, there is a plain cylindrical

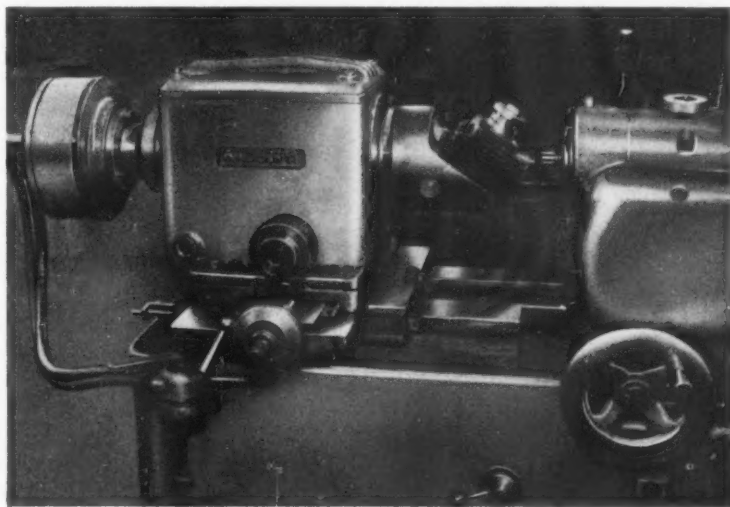


Fig. 13. The Thread on the Exhaust Stub is Milled on this Special Innocenti-built Machine on which the Casting is Clamped by the Large Air Cylinder at the Left

mandrel, which is a good fit in the casting bore. The casting is loaded in the inverted position, and is located by dowels, which enter the stud holes. A C-washer is then inserted beneath the headed end of a draw-bar which projects from the mandrel, after which an air valve is operated to pull down the draw-bar to clamp the component. This valve supplies compressed air to the ram side of the piston in the cylinder at the left in Fig. 13. A draw-bar within the work spindle is thus pulled to the left, and this movement is transmitted to a lever, pivoted near its centre, inside the work-fixture. The other end of this lever is connected to the fixture draw-bar, which passes through the mandrel, and, as the lever is turned, this draw-bar is pulled down to clamp the casting.

On the spindle of the milling head, at the right in Fig. 13, is mounted a cutter of approximately 1 in. diameter, and slightly less than 1 in. long, with eight straight gashes. Both spindles are driven by the same motor, the work being rotated at a speed of 1 rev. in 50 sec. The cutter is run at 240 r.p.m., and the axes of both spindles are horizontal and at the same level. After a casting has been loaded, with the work-head in the retracted position shown, the head is moved to the right against a stop, so that the end of the exhaust stub overlaps the end of the cutter by the length of the required thread minus one pitch. Next, the driving motor is started, by pressing a button at the right of the machine base, and the work-head is fed sideways towards the cutter by a cam, to the correct thread depth. The work-head is then traversed

longitudinally through a distance of one thread pitch, after which a rise on the cam retracts the work from the cutter, and the machine stops automatically. Finally, the work-head is moved to the left for re-loading.

Three Rosa (William Urquhart) pillar drilling machines are next employed for milling chamfers on the edges of the ports within the cylinder. Each machine has a long spindle, with a special milling cutter, to suit the shape of the port, at its lower end. The casting is placed in a sliding fixture in which it is located by the spigot, and the spindle is lowered inside the bore to a stop. By means of a lever on the fixture, the casting is then moved into contact with the cutter for the chamfering operation.

LAPPING AND INSPECTION OF CYLINDER BORES

From the thread-milling machine, the castings are taken to an Innocenti test bench, where they are fitted with gaskets and covers, which close off all the openings. Then, air at a pressure of about 60 lb. per sq. in. is admitted to the cylinder bore, and the casting is immersed in water, so that any leaks through cracks or porous areas in the casting are revealed. Only very occasionally does a casting fail to pass this test.

The last machining operation on the cylinder casting is performed on the Micromatic (Jones & Shipman, Ltd.), vertical honing machine shown in Fig. 14, on which the bores are honed to a diameter of $57 + 0.019$, -0.000 mm. In the

fixture provided on this machine, the casting is lightly clamped, with the spigot end in a register, by means of a bush plate guided on vertical plungers at each side. This plate is pulled down by a heavy steel ball on the end of a lever, whereby the plungers are raised and lowered for loading

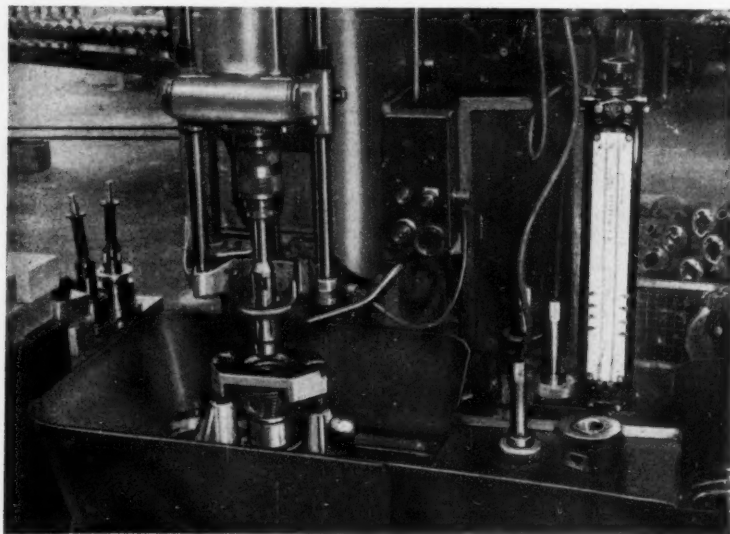


Fig. 14. Cylinder Bores are Honed to Limits of $57 + 0.019 - 0.000$ mm on this Micromatic Machine. A Solex Air Gauge is Provided for Checking

purposes. The honing head employed is fitted with six stones, each measuring about 2 in. long by $\frac{1}{4}$ in. wide, the specification being varied if necessary to suit the hardness of the castings. A typical specification is Micromold 19A-180-L9-VBE. The pressure applied by the honing stones is more effective at the upper end of the bore, due to the support afforded by the fins, than at the lower end, where the spigot tends to expand slightly. To remove the required amount of material from the spigot end of the bore, therefore, a number of additional short strokes of the hone is necessary at that end.

This selective honing is accomplished by connecting a length of flexible cable to the operating lever of the valve, which reverses the direction of the honing slide at its upper end. By operating this valve by hand, with the aid of the cable, the hone is caused to reciprocate on a short stroke, at the lower end of the bore, as many times as the operator judges to be necessary to ensure a parallel bore. As may be seen at the right in Fig. 14, Solex air gauging equipment is employed to check the bore size as honing proceeds, ring gauges being provided for checking the calibration of the manometer tubes when necessary.

Honing completed, the cylinders are washed in paraffin in a special booth, in which nozzles are employed to direct the fluid into all the crevices and passages to ensure the removal of any loose particles and foreign matter. After they have been dried, the castings are passed to an inspection bench, where an electrical gauge is used to check all the cylinder port openings in the bore for height and angular position. This gauge takes the form of a cylindrical mandrel, over which the castings are placed, with plungers at positions corresponding to those which the ports should occupy. If these plungers are prevented from entering the port apertures fully, signal lamps on a panel are illuminated.

Finally, the cylinders are again inspected for bore diameter and are graded into three sizes of 57 to 57-006, 57-007 to 57-013 and 57-014 to 57-020 mm. These grades are distinguished by marking the castings with minus, zero, and plus signs, for subsequent selective assembly with the three grades of piston mentioned in the previous article.

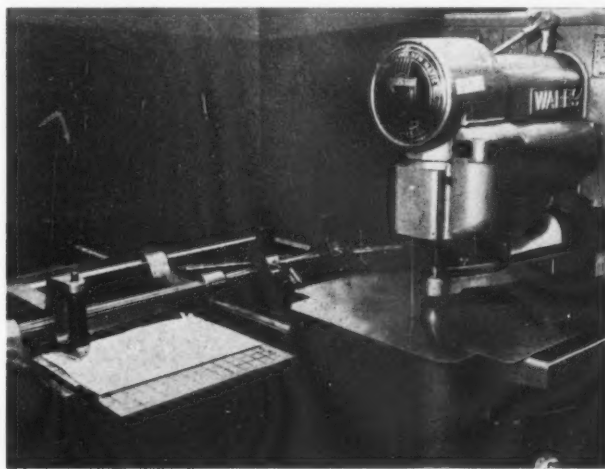
A further article devoted to the production of components for Lambretta motor scooters will be published shortly in MACHINERY.

Grid Layout Table for Use with Hole Punching Machine

At the works of the Martin Company, Baltimore, 3, U.S.A., important savings are being obtained by the use of the grid layout table seen in the illustration, which has been designed and constructed by the company for use when punching holes in experimental chassis plates on a Wales machine. Normally, each plate requires a different hole pattern, so that it is not economical to provide templates.

With the layout table and a tracer control unit, the holes are punched from a blueprint of the chassis. The table measures 30 by 40 in., and when setting up, the drawing and work sheet are correspondingly positioned with reference to a datum hole. Tape is employed to secure the blue-

print to the table, and, with the tracer set to each hole centre in turn, the control lever is depressed for the punching operation. Holes ranging from $\frac{3}{8}$ to $3\frac{1}{2}$ in. diameter are punched with this equipment, and provision is to be made for punching square, oblong, and keyhole shapes. Normally, a full-size blueprint is employed, but if required hole patterns can be punched at ratios other than 1:1.



With this Grid Layout Table Holes Can be Punched in the Required Positions from a Blueprint

Production Set-ups on Six-spindle Conomatic Machines

A Conomatic 3½-in., 6-spindle automatic, now made in this country by the Cone Automatic Machine Co., Ltd., Aldridge, Staffordshire, is being used at the works of Vauxhall Motors, Ltd., Luton, Beds., for the production of a striking lever shaft coupling. This component has an eccentric boss, in which a slot is milled. Made from special En.32b bar stock, of 1-in. by 2½-in. section, with

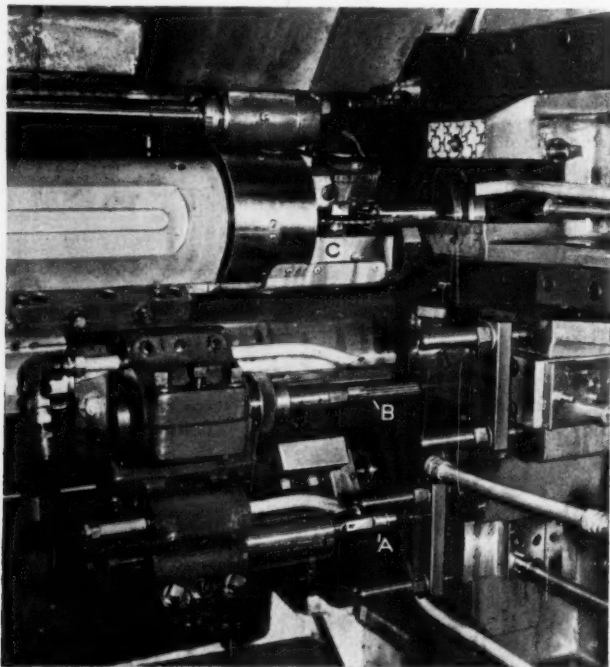


Fig. 1. Close-up View of the 3½-in. Conomatic Machine Set Up for Machining a Striking Pin Lever. The Milling Attachment for Cutting a Slot is Shown at C

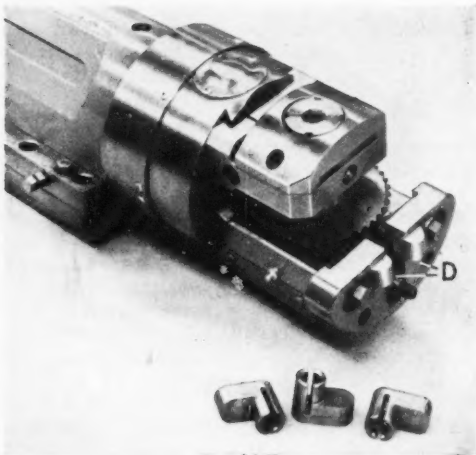


Fig. 2. A Front View of the Milling Attachment Seen at C, Fig. 1, with Some Finished Parts

radiused corners, the levers are turned at a surface speed of 102 ft. per min., and each is completed in a cycle time of 1 min. 40 sec.

Special collets are employed to position the bar for machining the eccentric boss, and the bar is fed to a stop after parting off at the sixth spindle position. A 1-in. diameter stub drill, carried in the main slide, centres the end of the bar at the first position, ready for drilling. Simultaneously, a tool, on the cross-slide, breaks down the eccentric boss portion of the succeeding component. This tool, therefore, faces the back of the component produced at the cycle here considered, the boss portion of which previously has similarly been reduced.

Another, wider, break-down tool is applied at the second spindle position, and a separately adjustable tool, in a combination holder, machines the face of the eccentric boss. At the same station, a ½-in. diameter drill, carried in the main slide, is fed in to depth, and a knee tool, also mounted on the main slide, turns the eccentric boss portion.

At the third spindle position, indicated at A in Fig. 1, a similar knee-turning tool further reduces the

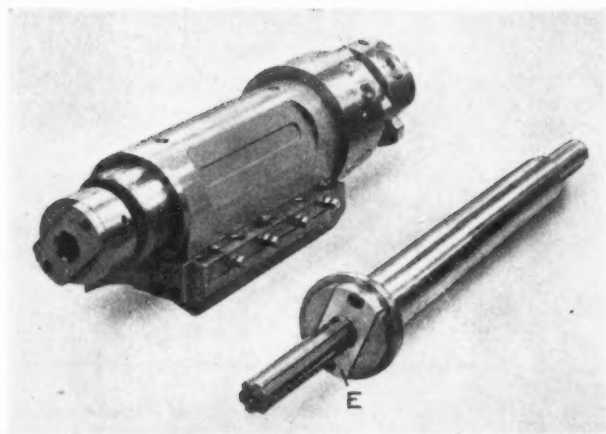


Fig. 3. A Rear View of the Milling Attachment Seen in Fig. 1. The Drive Shaft for this Attachment is Shown in the Foreground

boss diameter, and the $\frac{3}{8}$ -in. diameter hole is bored out, in preparation for reaming, by a tool on the main slide. At the same time, a tool on the cross-slide begins the parting-off operation.

Breaking-down for part-off is continued, at the fourth spindle position, by a narrower tool, while a form-tool on the same cross-slide, finish machines the eccentric boss to 1.0-in. diameter, and produces the chamfer. In addition, at this spindle position, a floating reamer *B* is fed in by the main-slide to finish the 0.625-in. diameter hole.

The transverse slot is machined at the fifth spindle position by the attachment *C*, Fig. 1, and front and rear views of this milling attachment are given in Fig. 2 and 3. Drive to the attachment is taken from the right-hand end of the machine, by means of the splined shaft seen in the foreground of Fig. 3. The shaft is here shown in a reversed position, and, when assembled, the splined portion engages the hole in the rear of the milling attachment. From the shaft, the 5-in. diameter milling cutter is driven, through planetary bevel gears, at a speed of 128 r.p.m.

The slot in the striking pin lever is required to be at 90 deg. to the longitudinal centre line of the workpiece, within fairly close limits. As the milling attachment advances towards the work, the milling cutter is already within a few degrees of its correct angular position, and the final location is effected by means of the pair of radiused pads, indicated at *D* in Fig. 2. These pads engage the flat sides of the component and, by turning the milling quill

within its housing, locate the cutter accurately in relation to the longitudinal centre line of the workpiece. To accommodate this angular positioning movement, the spline bushing *E*, Fig. 3, has a limited amount of angular float.

At the sixth spindle position, the workpiece is parted-off by a tool mounted on the cross-slide. Some finished pieces are seen in the foreground in Fig. 2.

PRODUCING V-GROOVED SLEEVES

The sleeve shown in section at *X*, in Fig. 4, is being produced at the works of the Laycock Engineering Co., Ltd., Millhouses, Sheffield, Yorks., on a $1\frac{1}{8}$ -in., 6-spindle Conomatic. Particular importance is attached to concentricity between the 0.875- and 1.2095-in. diameters, and to the surface finish of these two portions. The

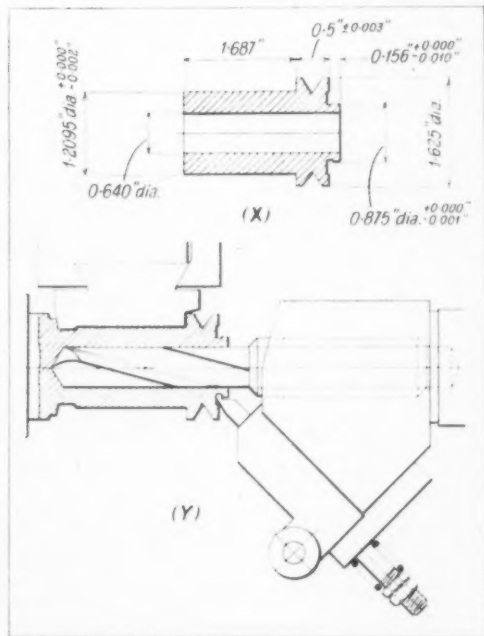


Fig. 4. (X) - Sleeve Produced on a $1\frac{1}{8}$ -in. 6-spindle Conomatic Machine in a Cycle Time of 25 sec. (Y) - Tooling Employed at the Fourth Position

This land serves as a track for two steady rollers, which are mounted on the main-slide, and serve to support the work while the $\frac{3}{8}$ -in. diameter spherical portion is being rough machined by a form tool carried on the cross-slide.

Next, the $1\frac{1}{8}$ -in. diameter spherical portion, and the tapered neck, are rough machined, from the cross-slide, the workpiece being supported at this stage by means of a free-running female cone steady, on the main-slide, which engages the previously machined $\frac{3}{8}$ -in. diameter ball.

At the third spindle position, a grooving tool on the cross-slide forms the undercut between the two spherical forms. At the same time, other tools on the cross-slide finish machine the $\frac{1}{2}$ -in. wide recess, and take a second cut on the $1\frac{1}{8}$ -in. diameter ball.

A roller steady is again applied at the fourth spindle position, where a form tool on the cross-slide finish machines the tapered neck, and the $1\frac{1}{8}$ -in. and $\frac{3}{8}$ -in. diameter balls. At the fifth spindle position, a combined tool-holder and roller steady is provided. A tapered steady roller bears on the neck of the workpiece, and a roller of concave radiused form supports the $1\frac{1}{8}$ -in. diameter spherical portion. The steady rollers are carried on the cross-slide tool-holder, and come into position as the tool is fed tangentially to take the final shaving cut. At the sixth position, the finished component is ejected and the fresh blank is loaded, by the arrangements that have been described.

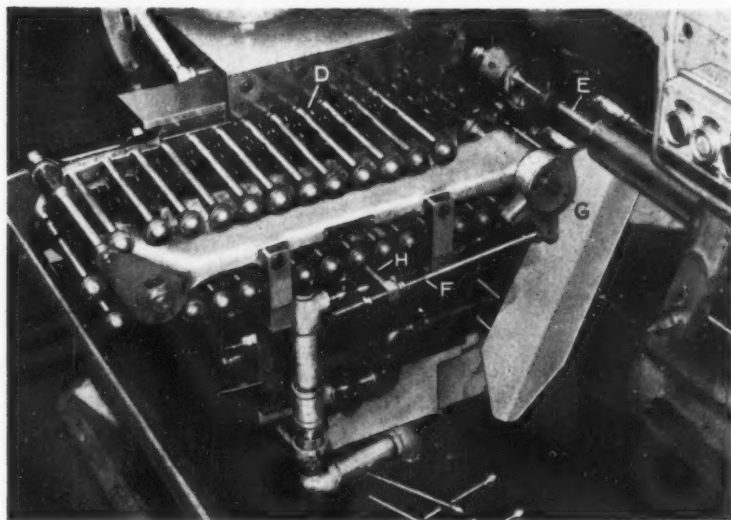


Fig. 6. Close-up View of the $1\frac{1}{2}$ -in. Conomatic Machine, Showing the Loading Conveyor which is Mounted on a Special Cross-slide at the Sixth Spindle Position

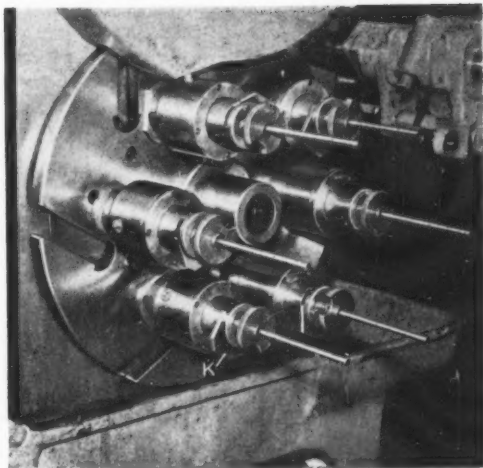


Fig. 7. Rear View of the Machine in Fig. 6, Showing the 3-position Stops Employed when Machining the Components Shown in Fig. 5

To enable three part-lengths to be handled, as indicated in Fig. 5, a 3-position selector unit and end stop is incorporated in each work spindle. The different positions are determined by three accurately-spaced slots in the outer end of each stop, with one of which a narrow forked member K, Fig. 7, is engaged, to give the required setting, with a minimum of change-over time.

SKIVING KNIVES
COATED WITH TUNGSTEN CARBIDE by the Linde Flame-Plating process are being used for cutting rubber, and it is claimed that they can be used 40 times as long as untreated knives, before they require to be re-ground. Flame-Plated knives are self-sharpening, since the 0.002 in. thick carbide wears more slowly than the steel body. Flame-Plating is now being carried out by John Harris Tools, Ltd., Warwick.

Production of Stainless Steel Collector Rings for Exhaust Gas Thermocouples

An assembly of stainless-steel tubing and fittings forms a housing for thermocouple wires, whereby gas turbine exhaust temperatures are measured. The assembly serves as a collecting ring, and provides for any number of thermocouples required on the engine tail-cone. When the collector ring is installed on the unit and the latter is started up, an electromagnetic force is generated and recorded on a millivoltmeter. This meter is calibrated to register directly in deg. F.

Airtron, Inc., Linden, N.J., U.S.A., produce such assemblies which are made to exacting standards,

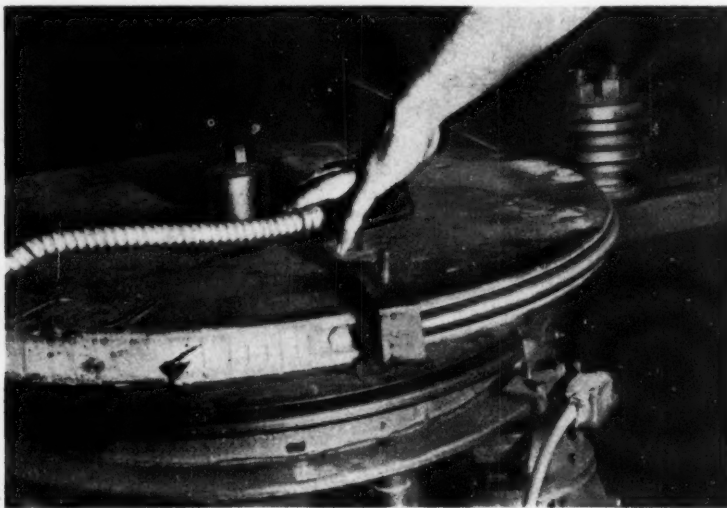


Fig. 1. The Arm is Arranged to Reverse Automatically when the Tube has Been Bent through a Half Circle



Fig. 2. When this Tool has Been Inserted in the Tubing, a Nut is Tightened to Expand the End of the Tube by $\frac{1}{8}$ in.

since they must withstand temperatures between 600 and 1,000 deg. F., also vibration, engine shock, and corrosion by the atmosphere and fuel.

The tubing (supplied by the Alloy Tube Division of Carpenter Steel) is Type 430 welded stainless steel, of 1-in. outside diameter by 0.035-in. wall thickness. This tubing serves as a conduit for the two thermocouple wires (of Alumel and Chromel) and whereas it was selected as most suitable for the service conditions involved, it also has proved very satisfactory from the standpoint of silver-soldering the fittings.

Each harness is composed of two half-circles of tubing, and they are made in diameters, from 12 to 36 in. Incoming tubing is inspected for dimensional accuracy, which must be within 0.003 in. before it is issued for production. It is first bent, by an elec-

tric motor-driven arm, around a table as may be seen in Fig. 1.

No mandrel is employed. A roller on the rotating arm squeezes the tubing against the concave rim of the table. While a clamp holds one end in place, the arm is turned to bend the tubing through slightly more than 180 deg. The arm is set to stop automatically when the roller reaches the end of the tube, and then to return to the starting position.

After the tube has been bent, a short length is removed from each end on an abrasive cut-off wheel, to leave a half-circle. Both ends are then deburred, the internal burrs being removed with a flexible-shaft grinder. Next, both ends are expanded about $\frac{1}{2}$ in., with the small flaring tool seen in Fig. 2. The tool is inserted in the tubing, and a nut on the top is tightened with a wrench.

A threaded ferrule is next silver-soldered to each end. These ferrules hold couplings, whereby the half-circles are joined.

When a ring has been assembled, it is positioned on a Bridgeport milling machine, and a

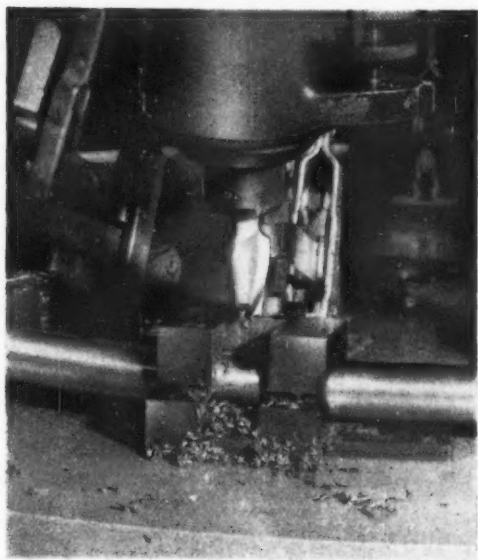


Fig. 3. An End-mill is Employed to Cut Holes at a Slight Angle Through One Wall of the Tubing

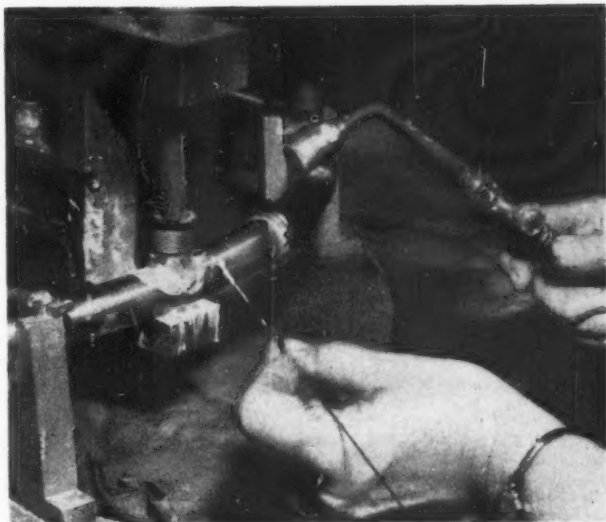


Fig. 4. A Fixture with an Arm in the Form of a C-clamp secures the Outlet to the Ring for the Silver-soldering Operation

series of $\frac{1}{16}$ -in. holes (from 9 to 16 holes, depending on the size of the ring) is drilled through one wall, to receive threaded outlets for the thermocouples. The holes are at a 6-deg. angle, and to avoid deflection they are drilled with a two-lipped end-mill, as may be seen in Fig. 3. During this operation, the ring is supported between split blocks which are spaced around a rotary table. Toggle clamps are provided for opening and closing the blocks rapidly, and the table is indexed accurately to each hole position.

The outlets, of type 416 stainless steel, are prepared by sanding, and then tinned with solder. For the silver-soldering operation, the fixture seen in Fig. 4 is used. After the surfaces have been fluxed, an outlet is placed in one of the holes. An arm, in the form of a C-clamp, secures the fitting to the ring while it is being soldered. The ring is indexed beneath the clamp until all outlets have been assembled.

After the flux has been cleaned off the joints, the ring is sand-blasted. Each assembly is inspected thoroughly. Outlet threads are checked with "go" and "not go" gauges, and a torque wrench is applied to each outlet to test the strength of the soldered joint.

The Alumel and Chromel wires, both of 0.162-in. diameter, are bent to a circle in a jig. After being sheathed in fibre glass, the wires are passed through ceramic spacers, which are placed at varying inter-



Fig. 5. There is a Tee on Each Wire at Each Outlet. When Assembling the Collector Ring it Must be Ensured that the Tees Line-up with the Outlets

vals around the loop. At each thermocouple outlet position, special tees are soldered to the wires.

Insertion of the wires in the ring, as seen in Fig. 5, requires considerable dexterity, to ensure that the tees are kept in the proper position as

the wire is passed through each half-circle. The ends of the wires are joined and soldered in sleeve adapters, and couplings are screwed on to the ferrules, to join the two halves of the ring. Finally, through each outlet, one Alumel and one Chromel pin is screwed into a tee. Two ceramic insulators are placed over the pins to hold them in place, and a stainless-steel snap-ring is added to support the insulators.

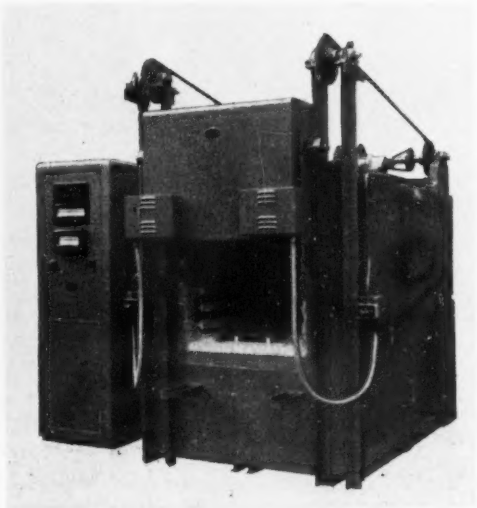
The completed assembly is polished by hand, and receives a light plastics coating as an extra protection against tarnishing. Before dispatch, it is subjected to a thorough electrical check for performance, including an earth resistance test after exposure to humid conditions.

Hedin Box Furnace

Hedin, Ltd., Commerce Estate, London, E.18, have recently added a series of heavy-duty box furnaces to their range, and the accompanying illustration shows one of these furnaces, which has internal dimensions of 54 in. by 24 in. by 18 in. The temperature control is fully automatic, and the furnace has a maximum working temperature of 1,150 deg. C. and a rating of 60 kW.

Power operation of the door is controlled by push buttons, which are duplicated on the right- and left-hand sides, and the heating elements are of heavy section 80-20 nickel-chromium alloy. Elements are fitted both to the walls of the chamber and to the inside of the door, so that an even temperature is obtained throughout. An indicating controller is included, which may be set at a few degrees above the operating temperature, to protect the heating elements and the charge, and in the event of the failure of one phase of the supply, the remaining two phases are automatically cut off in order to prevent an unbalanced load on the mains.

These furnaces provide for rapid heating, and are suitable for vitreous enamelling, also annealing, case-hardening, stress-relieving, normalizing and other heat-treatment processes.



Hedin Heavy-duty Box Furnace

Operations on Perforated Drums and Housings for Dryers

By HERBERT CHASE

Production of dryers for home laundry use is among the principal activities of the Hotpoint Co., Chicago, Ill., U.S.A. Two of the more important sheet-metal components are the perforated drum in which the clothes are tumbled, and the housing which encloses the drum. Some of the operations involved in the production of these items are here described.

The 0-037-in. thick steel sheet for the drum cylinder is perforated in a Clearing press, as may be seen in Fig. 1. Operating at a speed of 182 working strokes per min., the press is equipped with 86 punches, arranged in two staggered rows of 43. These rows are disposed at right-angles to the direction of movement of the stock through the press. Lubricant is applied to the punches occasionally, by hand. The sheet is fed by Littell rolls, which provide 43 automatic indexing movements per piece, resulting in a total of 86 rows of holes.

All the holes are pierced in two large areas, which are approximately square. The feed cycle is automatic, and the punches remain idle while areas not to be pierced are moved forward. With this arrangement, uniformity of groupings is maintained for all sheets.

Pierced slugs fall through the press bed on to a conveyor, whence they are discharged into a scrap box. One man feeds a sheet to the press by hand, and then walks round to the rear to remove the pierced sheet and stack it.

Each sheet is delivered to a second press where it is notched and trimmed, and the door opening is pierced out. Then, three paddles are formed, by V-shaped inward bends. After the piece has been rolled to a generally cylindrical shape (still including the inward bends), the two ends are joined by gun spot-welding. A flange around the door opening is then extruded outwards.

The end plates are circular stampings, which are flanged around both their periphery and a large central hole. These plates are assembled to the perforated cylinder and are gun spot-welded in place. The assembly is then mounted on a fixture on a Maplewood machine, and the peripheral flanges are crimped to the cylinder, one at a time.

Housings, to enclose the dryer drums, are produced from sheets which are first blanked to size, and then are pierced and embossed on a 2-station hydraulic machine. After the sheet has been rolled to a cylindrical shape, it is placed in a National seam-welder, where it is clamped and the ends are joined by a longitudinal seam.

Next, the cylinder is placed in the double-ended flange rolling machine shown in Fig. 2, which was built by the Hotpoint Co. This machine has one

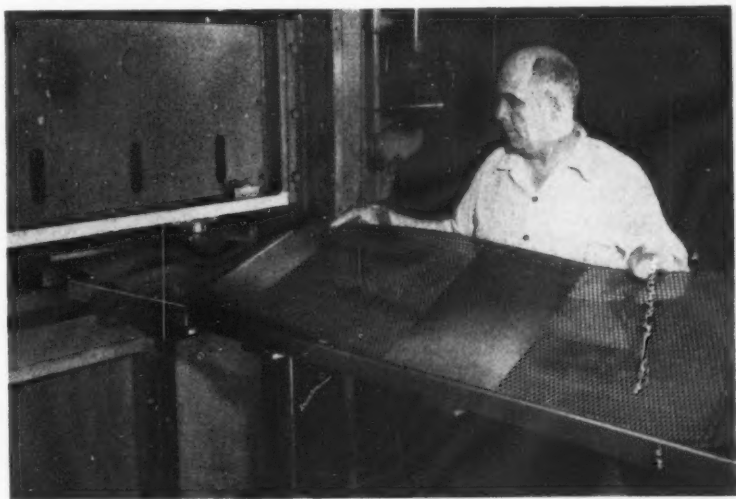


Fig. 1. This High-speed Press Operates at the Rate of 182 Strokes per min. to Perforate Blanks for Drum Cylinders. Two Rows of 43 Holes are Pierced at Each Stroke

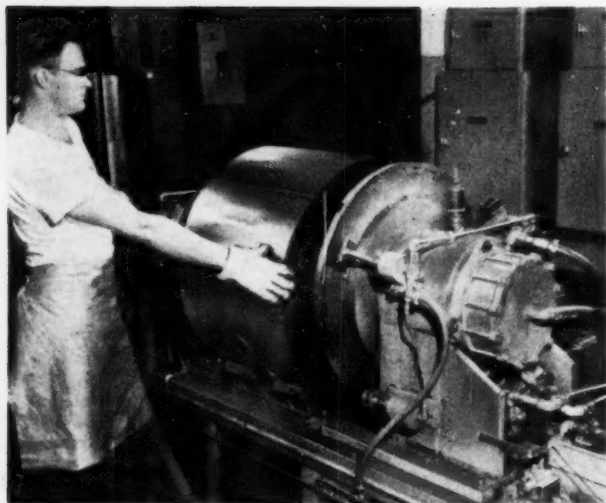


Fig. 2. The Cylindrical Drum Housing is Flanged on this Special Machine. Two Heads Enter the Cylinder and are Expanded to Position and Rotate it. Two Sets of Rolls then Form the Flanges Outwards

fixed and one movable head. After the piece has been placed over the fixed head, to a gauged depth, the head is expanded to hold it securely. The movable head then is advanced into the opposite end, to the correct depth, and expanded. A set of

rolls at each end then forms the metal outwards, as the cylinder is rotated, to produce two flanges. When flanges have been completed, both heads are contracted and the cylinder is removed.

Subsequently, the flanged cylinder is transferred to a double-head seam welder, where it is positioned vertically in a fixture. A rectangular bulkhead is placed over the cylinder and the welding heads are lowered.

The fixture is then turned through an arc of 180 deg., and circular seam welds are produced to secure the rectangular stamping to the cylinder flange. A second bulkhead is welded to the flange at the opposite end of the cylinder on a similar type of machine.

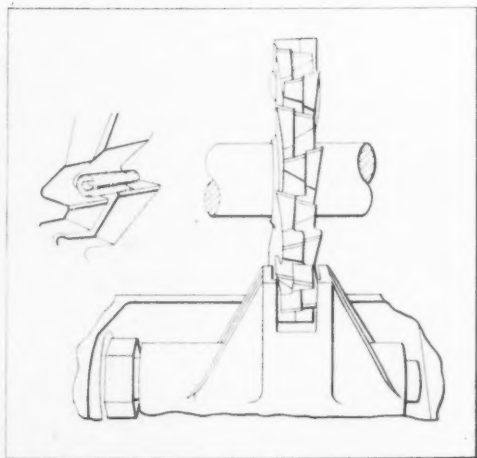
Barber-Colman Milling Cutter for Deep Slotting Operations

A range of interlocking, staggered-tooth, side-milling cutters is being made by the Barber-Colman Co., Rockford, Illinois, U.S.A. These cutters have a patented arrangement of staggering, whereby the trailing corner of a leading tooth is slightly in advance of the leading corner of the adjacent tooth. This layout is shown in the accompanying figure, and is said to allow an uninterrupted flow of chips, with the result that cutting temperature is lowered, and risk of tooth breakage reduced.

It is also claimed that the depth of cut which can be taken is limited only by the diameter of the cutter boss, and that spindle speeds and feed rates in excess of those possible with conventional cutters may be used. By means of shims, between the two interlocking parts, the nominal width of the cutter can be maintained after sharpening, and,

in the same manner, one pair of cutters can be adjusted for milling slots of various widths.

These cutters are recommended for deep-slotting operations in steel, or non-ferrous materials. The makers are represented in this country by Barber & Colman, Ltd., Brooklands, nr. Manchester.



Barber-Colman Interlocking, Staggered-tooth, Side-milling Cutter. The Inset Shows the Type of Chip Produced by this Tooth Arrangement

5th EUROPEAN MACHINE TOOL EXHIBITION, HANOVER

Fourteenth Article

HASENCLEVER DEVELOPMENTS

The German firm of Hasenclever, who are represented in this country by Paul Granby & Co., Ltd., 39 Victoria Street, London, S.W.1, presented an extensive exhibit. This company is well-known for developments in the field of electric upsetting, and the equipment demonstrated included the 80-kVA. horizontal machine, type HG80/500, seen in Fig. 1. This machine incorporates a number of improvements to enable alloys that normally present difficulty to be processed on an automatic or semi-automatic cycle. The horizontal machines are intended particularly for upsetting long bars, and special equipment has been developed to prevent thin stock from bending, and to permit the formation of accurate cylindrical heads directly in the upsetting dies, so that the need for subsequent operations on finishing presses is avoided.

On the machine shown, the upsetting stroke is 20 in., and bars from $\frac{3}{8}$ to 1 $\frac{1}{2}$ in. diameter, up to 63 in. long, can be handled. It is hydraulically operated, and the self-contained pump unit is driven by a motor of 15 h.p. Hasenclever electric upsetting machines are made in both horizontal and vertical types, with ratings from 10 to 500-kVA., and with capacities for round bars from $\frac{3}{8}$ to 4 in. diameter, or bars of other shapes of equivalent area of cross-section. The larger machines are operated hydraulically, and the smaller types by compressed air.

Particular advantages afforded by the process include rapid and closely-controlled heating of the bar from the inside to the outside, so that the work remains practically free from scale, and a high degree of uniformity in the volume of upset, which enables finish-forged parts to be produced with minimum machining allowances. Moreover, a very favourable grain flow is obtained, and a considerable length of bar can be gathered without difficulty, with the upset at the end, or in any desired intermediate position. The shank of the workpiece remains cool throughout the upsetting cycle, and finish forging operations can readily be performed, at the same heat, if a suitable press, conveniently located is adjacent to the electric upsetter.

An outstanding application of electric upsetting is for the production of valves for internal combustion engines, the upset head being finish forged in a Vincent-type friction screw press. The round bar stock employed for this purpose is smooth-drawn or ground, and may be of the same diameter as the finished stem, or in certain cases, may have an allowance for finish grinding. During the

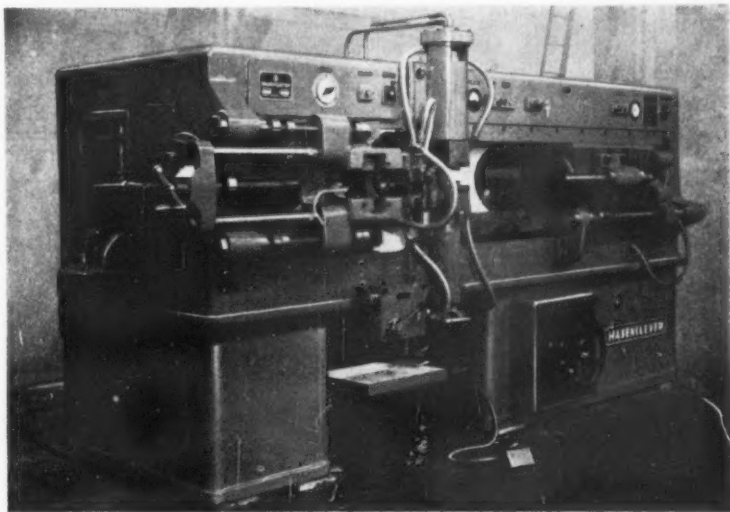


Fig. 1. Hasenclever Type HG80/500 Horizontal Electric Upsetter of 80 kVA. Rating

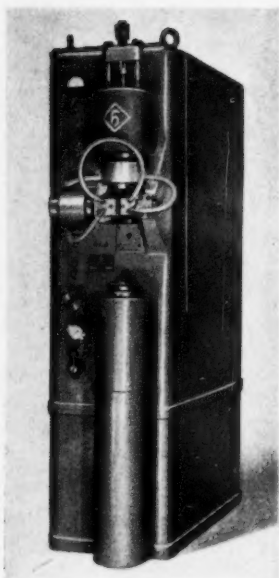


Fig. 2. Hasenclever Type VHG20/180, 20-kVA. Vertical Electric Upsetter, as Employed for the Production of Internal Combustion Engine Valves

operation, the stem is not damaged in any way by the light, sliding pressure exerted by the electrode jaws. Finish forging is carried out at one stroke on a Vincent press, and the accuracy is such that no trimming or turning is required. The only subsequent operation

necessary, therefore, is the grinding of the valve seat, and, if required, the stem diameter. Depending upon the shape and size of the valve head, the upset length ranges from 8 to 30 times the stem diameter.

Fig. 2 shows a Hasenclever type VHG 20/180 vertical, hydraulically-operated, electric upsetter, which, among a variety of other applications, is used for the production of valves. It is rated at 20 kVA., and will handle bars from $\frac{7}{8}$ to $\frac{3}{4}$ in. diameter, up to 13 in. long. The maximum upsetting stroke is 7 in., and the hydraulic pump is driven by a 7½-h.p. motor. As soon as the bar is placed in position between the clamping electrodes, the upsetting cycle is started automatically.

A Hasenclever Vincent-type VPS 190 screw press, which was exhibited in conjunction with the vertical electric upsetter for the production of valves, is shown in Fig. 3. It has a capacity of 355 tons, and can be operated at a speed of 28 strokes per min. The slide stroke is 18 in., and valves with heads up to 4 in. diameter can be finish forged. Drive to the press is taken from a motor of 40 h.p., and the cycle is controlled by push button. The strength of blow, and length of stroke, can be adjusted precisely, so that forgings of accurate shape are consistently produced. An installation, comprising an electric upsetter and a press, can be provided with work handling equipment to form a fully-automatic valve production unit with a high rate of output. This work handling

equipment can easily be removed, if required.

Features of the Vincent-type screw presses include a single-piece frame of high-tensile cast iron, and a slide built up from forged-steel components, which is provided with long bearing surfaces, and is balanced by air cushions incorporated in the frame. The centre drive disc is a steel casting, with a chrome leather and Nylon friction band, which moves slightly around the periphery at each stroke, so that even wear is ensured. An electro-pneumatic control system is fitted, which enables the working pressure required for a particular operation to be accurately pre-set. By means of a selector switch, the press can be set for inching, under push button control, to facilitate tool setting. When the press is set for running, control may be either by push button or pedal, and, on completion of the stroke, the slide comes to rest in the lowest position. Alternatively, the press can be arranged for continuous operation. All the moving parts are lubricated by a centralized one-shot system.

Reference may also be made to the type



Fig. 3. Hasenclever Type VPS190 Vincent Screw Press, of 355 tons Capacity

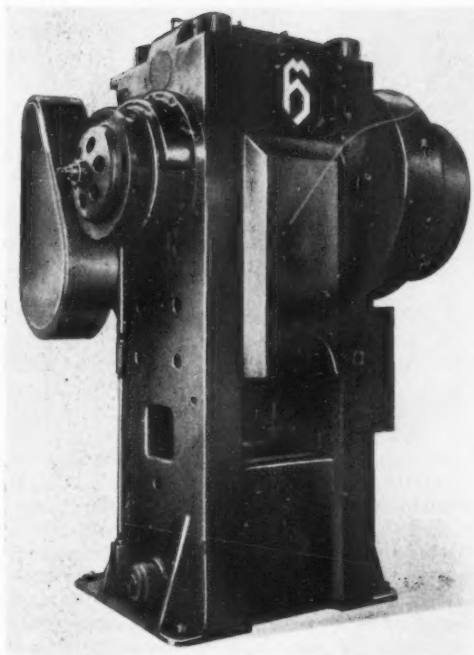


Fig. 4. Hasenclever 250-ton, High-speed, Eccentric-drive Forging Press

VEPE. 250 high-speed, eccentric-drive, forging press shown in Fig. 4, which is one of a range made in sizes up to several thousand tons. This press has a capacity of 250 tons and the speed of operation is 140 strokes per min. The ram stroke is 4.4 in., and the table dimensions are 20% by 21% in. Of all-steel construction, the frame has shrunk-in tie rods, and wedge adjustment is provided for the lower tools. Mechanical ejectors are fitted in both the table and slide, and the latter is pneumatically balanced. Drive is transmitted through gearing and a disc-type clutch and brake unit, which is actuated by a direct-acting air cylinder, and control may be either by hand- or foot-operated push button switches. The press can be set for single-stroke or continuous operation, also for inching to facilitate tool setting.

TRAUB AUTOMATIC LATHES AND CAM MILLING MACHINES

An example from the range of automatic lathes built by Hermann Traub Maschinenfabrik (Elgar Machine Tool Co., Ltd., 172-178 Victoria Road,

London, W.3), is shown in Fig. 5. Known as the type AF130, this machine has a capacity for chucking work up to 4.33 in. diameter by 5.5 in. long. A pole-changing motor, in conjunction with gearing, provides 12 spindle speeds from 200 to 2,500 r.p.m., and there is a separate motor for driving the feed camshafts. The cross-slide supports, also the end-working tool slide support, are carried on hardened and ground cylindrical guide bars, which are supported in bores in the headstock face and a bridge member.

Both longitudinal and transverse motions can be imparted to the horizontal slides by means of disc and drum type cams at the front and rear of the machine. An overhead vertical slide is operated by a disc-type cam on the front camshaft, through a bell crank and a linkage. Movement of the end-working slide is effected by a large drum cam mounted on the end of a central camshaft, and this slide may be employed for drilling, reaming, boring or simple forming operations. The speed of each camshaft may be changed by means of pick-off gears. A 3-jaw, air-operated chuck is fitted to the spindle. Machines of similar basic design are made for bar work.

The Traub type UKM 1 cam milling machine, illustrated in Fig. 6, is designed for the production of disc and drum type cams suitable for use on the automatic lathe and for other purposes.

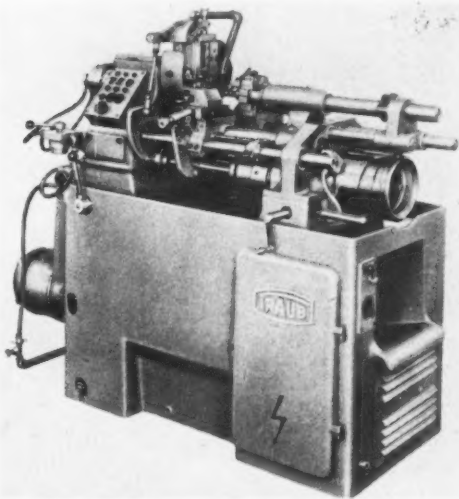


Fig. 5. Traub AF130 Chucking Automatic on which the Horizontal Slide and End-working Slide Motions are Obtained from Drum- and Disc-type Cams

On this machine, a cutter spindle is housed in a large casting at the right, and is driven by a two-speed motor and stepped pulleys, which provide six speeds. The casting is L-shaped, and the short horizontal leg has a large-diameter bore which engages a cylindrical column. Projections from the base and the bed of the machine support the column, and the spindle housing can be raised or lowered, to align the cutter with the work, by a rack and pinion arrangement operated by a hand-wheel.

The housing may also be swivelled so that end- or side-milling cutters can be used. After adjustment has been completed, the housing is clamped by bolts, the heads of which engage a T-slot machined in the vertical surface of the curved end of the bed casting projection. The quill, in which the cutter spindle is carried, can be adjusted axially for setting the cutter in relation to the work. The cam blank to be cut is mounted on a spindle which can be turned by a large handwheel, through a worm and wormwheel. A trunnion mounting for the work-spindle housing permits adjustment through 90 deg., to bring the spindle axis into the horizontal or vertical plane, and provision is made for clamping it in position.

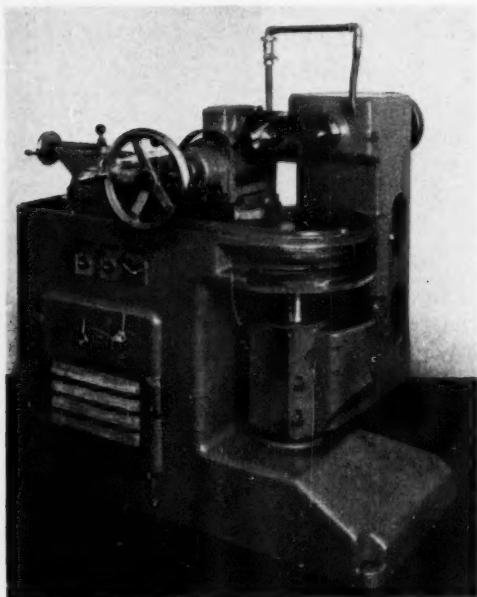


Fig. 6. Traub Milling Machine for the Production of Drum- and Disc-type Cams for Use on Automatic and Other Machines

The housing is supported on a carriage which is mounted on the dovetail ways of a sub-bed that is bolted to the T-slotted top surface of the main bed. At the left-hand end, the sub-bed embodies a tailstock-type housing for a quill, which has a slotted end projecting towards the spindle housing. This quill can be adjusted and clamped in the conventional manner. The moving carriage for the work-spindle housing has transverse ways for a cross-slide. The latter unit is moved by a lead-screw, which is driven from the work-spindle through a small gearbox, at any one of four ratios.

On the flat top of the cross-slide there is a plate with a straight and a curved edge on opposite sides. This plate is anchored by a pin near the straight edge, which is adjacent to the "tailstock," and it can be turned about the pin centre. Near the curved edge of the plate there is a similarly curved slot, through which projects a clamping stud with a nut, whereby the plate can be secured to the cross-slide after it has been adjusted. A flat surface near the curved edge of the plate is graduated in degrees, and there is a zero graduation on the cross-slide. The flat rear edge of the plate is engaged by a roller carried in the slotted end of the "tailstock" quill so that the two can be connected by a pin. The arrangement is such that when the plate is set to the required angle, and the cross-slide is traversed, the carriage is caused to move on its ways, to vary the position of the workpiece in relation to the cutter, so that the required rise or fall is produced on the cam profile. When a dwell portion is to be cut, the drive to the cross slide is disengaged. On this machine, drum cams up to 9.84 in. diameter, with a maximum length of 6.1 in., and disc cams up to 9.84 in. diameter, can be produced.

NUTAP COLD NUT PRESSES

A range of Nutap presses, for the production of hexagon and square nuts with chamfers at one or both ends, is built by Maschinenfabrik Schul & von den Steinen (Robert Speck, Ltd., Post Office Box No. 2, Rickmansworth, Herts.). These presses are made in three sizes, designated KMP 6, 8, and 10, for the manufacture of nuts from $\frac{3}{8}$ to $\frac{1}{2}$ in., at production rates of 125 to 92 per min., according to size. One of these presses is shown in Fig. 7. They are of the under-drive type, and the crankshaft is driven from a motor of 3.5 to 10 h.p., through a helical gear on a flywheel. The crankshaft has two throws, which are coupled, by substantial connecting rods, to blocks attached to the pairs of vertical columns, whereby the upper bolster is supported. At the driven end of the crankshaft, the weight of the flywheel is supported by means

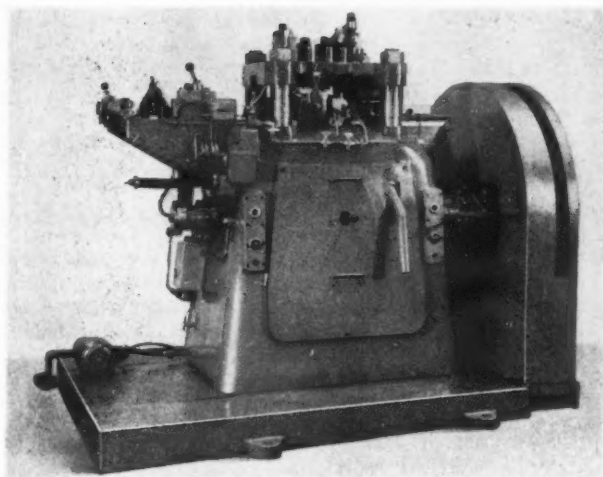


Fig. 7. Nutap Automatic Press for the Production of Square or Hexagon Nuts from Cold Strip Material at Rates up to 125 per min.

of an additional spring-loaded bearing, so that wear on the main crankshaft bearings and journals is reduced. The crankshaft bearings have forced lubrication, and there is a one-shot centralized system for the remaining bearings.

Tools for use on the machine are made normally from 12 per cent chromium steel. They are of simple design, so that production is facilitated, and are frequently of such a form that two or four sides can be brought into use. Repeated reconditioning is possible, moreover, so that punches and dies will produce several million blanks. Flat drawn stock is employed for nut-making, and is passed through a gripper feed to the five tool positions, which provide for punching the central hole and forming the sides. Coil ends are fed by means of a hand-operated lever, so that the full length of the stock may be used. During the operation of cutting off the partially-formed blank from the strip, which is performed at stage three, the work is supported from beneath by a reciprocating holder, so that all sides of the finished nut are vertical. Gripping fingers then transfer the blanks to the chamfering positions. Should these fingers fail to remove a blank, the press is automatically stopped. The fingers and other moving parts of the tools are operated by means of cams on the central portion of the crankshaft.

REINECKER WZS 5 UNIVERSAL TOOL AND CUTTER GRINDER

The German firm of J. E. Reinecker (Stuart Davis, Ltd., Much Park Street, Coventry), have introduced a new universal tool and cutter grinder, designated type WZS 5. A general view of this

machine is given in Fig. 8. A base of box shape supports the saddle casting, on which the table, guided by vee and flat ways, moves on rollers. The table is traversed hydraulically, and steplessly variable speeds from 3 in. to 16 ft. per min. are obtainable. Taper grinding may be carried out by swivelling the upper portion of the table up to 10 deg. in either direction, scales with widely-spaced graduations being provided to facilitate setting. The machine illustrated is fitted with an electrically-driven dividing head, which is operated automatically at the end of each double-stroke of the table. During the dividing movement, the table is locked in position hydraulically. The hardened and ground dividing discs are screwed directly on to the spindle. Provision is made for swivelling the head through 90

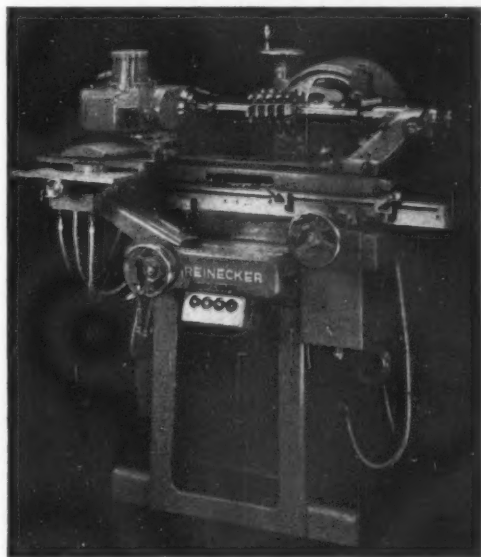


Fig. 8. A General View of the New Reinecker WZS 5 Universal Tool and Cutter Grinder, Fitted with an Electrically-operated Dividing Head

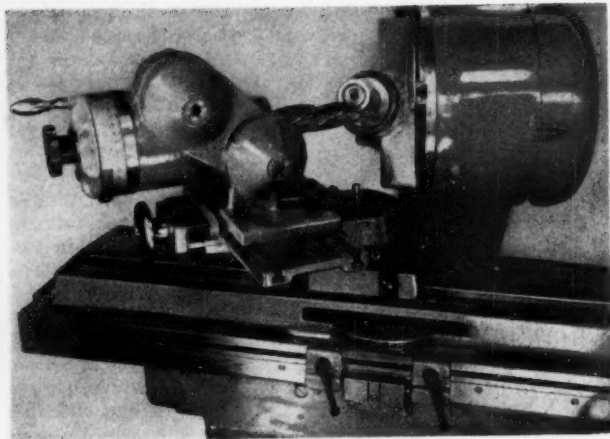


Fig. 9. The Grinding Head on the Reinecker ZSW5 Machine is Almost Totally Enclosed, and may be Adjusted through 360 deg. in the Vertical and Horizontal Planes, and Tilted through 30 deg.

deg., to enable angle cutters to be ground, and settings are made with reference to an accurate scale, calibrated in degrees.

A spiral grinding attachment is employed for the sharpening set-up shown in Fig. 9. This attachment incorporates a table, which is carried on a bracket on the saddle at the front of the machine and supports a variable-angle channel member. A follower moves along the channel, which is set to the required helix angle, and serves to turn the dividing head spindle as the table is traversed. Provision is made for a dwell period at each end of the table movement, and for shockless reversal. In addition, a compensating unit is fitted, which takes up the backlash at each reversal, so that grinding may be carried out during both directions of table traverse.

The head for the grinding spindle is mounted on a pedestal at the rear of the table. It can be adjusted vertically by means of a handwheel, and is counter-balanced to ensure easy movement. As may be seen from the close-up view, Fig. 9, the head is almost totally enclosed, and the spindle can be adjusted through 360 deg., in both the vertical and horizontal planes. In addition, the head may be tilted through a maximum angle of 15 deg., above and below the horizontal. The wheel spindle is mounted on ball bearings and can be fitted with a disc, cup or cylindrical wheel, up to 6 in. diameter by $\frac{3}{4}$ in. bore. Spindle speeds from 3,500 to 5,500 r.p.m. are available. Cutters up to 13 in. long by 10 in. diameter may be ground

on the machine, and several attachments are available, which enable a variety of operations to be carried out.

Arrangement for Wax Coating Steel Blanks

By HERBERT CHASE

Stampings of many shapes and sizes are produced in large numbers at the works of the Brown-Lipe-Chapin Division of General Motors Corporation, Syracuse, N.Y., U.S.A. In readiness for these operations, blanks are cut from coil or sheared stock and wax coated.

Two presses produce the blanks, one being fed with coil stock and the other with sheared strips. Blanks up to 30 in. long and 18 in. wide are cut from steel of 0.093 in. maximum thickness. Where the size permits two or more blanks are produced at each stroke of the press. The blanks are pushed through the dies and fall on to belts for transfer to a loading station. Here, they are placed by hand in steel racks carried by a continuous monorail chain conveyor. In the racks they are supported on edge between spacers, so that both sides are exposed.

Before the wax coating is applied, oil and grease must be removed from the blanks. For this purpose, the monorail conveyor carries them through a heated bath of North West No. 47 emulsion cleaner, and then through a cold water rinse. Air jets are applied to blow the water from the blanks.

Next, they enter a hot wax coating solution, and a thin film adheres to the surfaces. After they have passed through a warm air drying area, the coating has hardened sufficiently to permit the blanks to be unloaded and stacked by hand without sticking together. Subsequently the blanks are transferred to the presses, on which the forming and drawing operations are carried out.

A wax coating in this manner ensures good lubrication, facilitates drawing and helps to reduce scratching of the work and wear of the dies.

CRANES produced in this country during the first and second quarters of this year had an average monthly value of £2,283,000 and £2,246,000 respectively. For the whole year 1956, the average monthly value of cranes produced was £1,999,000.

Heavy Bending Operations

By A. W. JOHNSON

A modern factory of the Caterpillar Tractor Co., at Decatur, Ill., U.S.A., is laid out for flow production and assembly of motor graders and other earth-moving equipment. Among the interesting operations performed at these works is the cold-bending of steel plates to form blade beams. For this purpose, the plates are bent edgewise about an axis at right angles to the wide face of the section.

Two of these blade beam components are incorporated in the annular welded assembly seen in Fig. 1, which supports the blade beneath a Caterpillar motor grader.

Blade beams are produced from hot-rolled steel blanks, 1½ in. thick by 5½ in. wide. The material conforms to the company's own specification, and is similar to SAE 1020. The plates are bent on a type 4 Pines machine. To form a 10½-in. radius bend, the straight blank is first positioned on the bender against the form die A,



Fig. 1. Welded Assembly for a Motor Grader. Two Heavy Blade Beams Incorporated in the Assembly are Bent on Edge

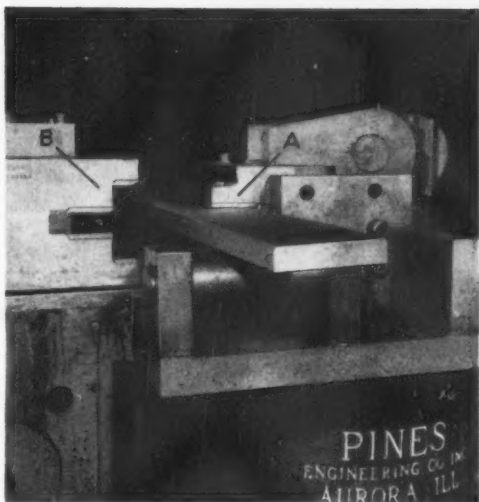


Fig. 2. The Steel Blank, 1½ in. Thick and 5½ in. Wide, is Here Seen in Position on the Type 4 Pines Bending Machine

Fig. 2, and guide D, Fig. 3. When the operator presses the "forward" button on the control stand, the work is automatically clamped, bent through a predetermined angle, and then unclamped.

Both the clamping die B and the pressure die C are designed to overlap an extension on the form die A, and thus fulfil two functions. The clamping die and the form die combine to impart both vertical and horizontal clamping pressure to the workpiece. In addition, the pressure die combines with the form die to confine the workpiece vertically, as it is being bent, thus limiting the amount of thickness increase.

Compression stresses are set up along the inside edge of the workpiece while it is being bent. These stresses would cause the material to thicken considerably on the inside of the bend, if the tools were not designed to confine it in the manner indicated. It may be noted that the form die A is constructed in two pieces, the top piece being hinged. When unclamping takes place, all vertical

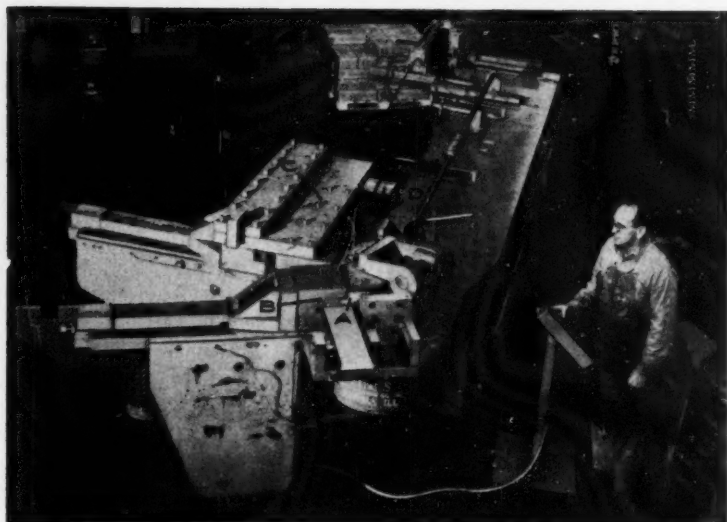


Fig. 3. Another View of the Machine Set Up for the Edgewise, 10 $\frac{1}{2}$ -in. Radius Bending Operation on the Wide Steel Plate

pressure exerted by the top piece is relieved, so that the work can be removed easily.

To ensure increased tool life, hardened wear-strips are provided on the surfaces of the clamp die and the pressure die which grip the work-piece, also on the clamp die, pressure die, and form die surfaces that over-ride each other. The guide *D* holds the workpiece in position before the bending cycle is started, and prevents it from twisting during the bending operation. A steel roller, mounted on the swinging arm in front of the clamp and form dies, greatly facilitates loading.

Approximately 1 $\frac{1}{2}$ hours are required to set up the bending machine when a batch is to be run off.

At another set-up on the bender, a 30-in. inside radius bend is made in the plane at right angles to that of the first bend. A fender brace is also formed by bending 2 $\frac{1}{2}$ -in. diameter steel tubing (of 0.187-in. wall thickness) to a 6-in. radius on the same machine.

Referring to Fig. 1, the two blade beams are welded to a 6 $\frac{1}{2}$ -in. diameter mounting ring, with a $\frac{3}{8}$ -in. fillet weld at the bottom and a $\frac{1}{8}$ -in. fillet weld at the top. Because of their rigidity, any distortion or inaccuracy of the beams, beyond the permitted tolerances, would result in difficulties in locating and clamping the components together in the welding fixture.

Trehwella Wallaby Winch

The 4-ton Wallaby winch, shown in use in the accompanying figure, is suitable for moving machinery, and is made by Trehwella Brothers Pty. Ltd., Rolfe Street, Smethwick, Birmingham. This winch is operated by hand-power only, and has two speeds and powers, the change being made by transferring the lever handle from one stub arm to another. Reverse rotation of the drum may be engaged by means of a lever. Of particularly compact design, as will be evident from the illustration, the winch is tested to 7 $\frac{1}{2}$ -tons. The weight, complete with handle and 40-ft. drum rope, is less than 150-lb.

The Trehwella 4-ton Wallaby Winch in Use for Moving a Machine



The Introduction of Numerically-controlled Machine Tools*

*Some Aspects of the Reorganization Undertaken
by The Martin Co., Baltimore Division*

By LEON E. LAUX†

The introduction of punched-card or tape controlled machines into a workshop which has hitherto used only conventional machine tools may necessitate a drastic reorganization of the existing methods and procedure if the potential advantages offered by these machines are to be exploited to the full. The Baltimore Division of the Martin Co., U.S.A., have recently installed the tape-controlled Kearney & Trecker profile-milling machine seen in Fig. 1, and an account of the preparations which were made may form a useful guide to the extent and nature of the changes required. The company started planning for the efficient operation of this machine one year before the date of delivery, and radical changes were made in almost every one of the existing departments. Staff were selected

and trained in the new methods of dimensioning working drawings, in the operation of the machine, and in the type of maintenance that would be required.

The existing methods and organization could not be abolished completely, as the majority of the workshop would still be equipped with manual or template-controlled machines, but a combination of methods was evolved, whereby an easy change-over from the conventional to the numerical control practice could be effected. To meet this requirement, the main changes were found to be those affecting the dimensioning of drawings.

In preparing the information which was to be included on the punched tape, it became apparent that the planning engineer would be the key man, since a comprehensive operations schedule would be essential for efficient use of the machine. Upon this operation sheet depends the preparation of the numerical control drawing, the compilation

of a process sheet in numerical code, and, finally, the punching of the tape itself. The procedure that has been adopted may be outlined as follows. A basic sequence of operations for a particular part having been established, a comprehensive list is prepared which describes, in detail, all the

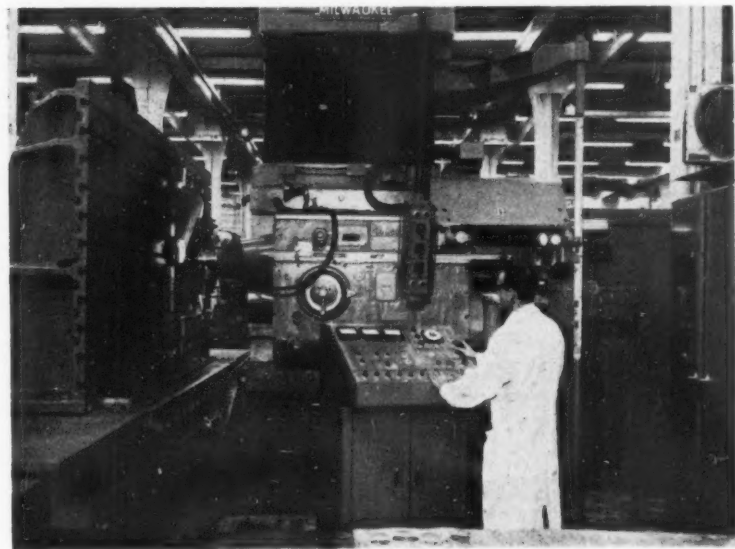


Fig. 1. Kearney & Trecker Three-dimensional Punched-tape Controlled Milling Machine Recently Installed at the Works of the Baltimore Division of the Martin Co.

* Abstract from a paper delivered by Mr. Leon E. Laux at the Third Annual Contouring Conference held at Los Angeles, California, U.S.A., on October 23 and 24, 1957.

† Head of Manufacturing Research and Development, The Martin Co., Baltimore Division.

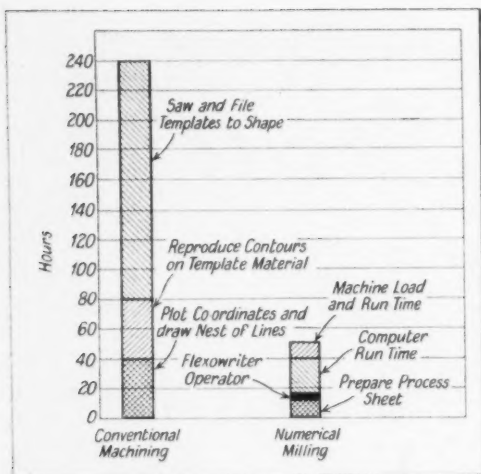


Fig. 2. Comparison Chart Showing the Time Required for Producing Aileron Templates by Conventional and Tape-controlled Methods

conventional and numerically-controlled operations involved, and a drawing is made, in pictorial form, on which the path to be followed by cutter is shown instead of the usual dimensions. The next step is to prepare an operation sheet with the various stages denoted in the numerical code, and, from this sheet, a paper process tape is produced by means of a Flexowriter typing machine. When this process tape has been checked, it is fed through the computer and the machine control tape is punched at the same time. All tape punching is performed in an air-conditioned and humidity-controlled room, and, after the machine control tape, and copies of the part drawing and the operation sheet, have been issued to the operator, all the remaining data are filed away for reference.

Particular attention must be given to the design of work-holding fixtures, clamps and cutters, so that the maximum rigidity is obtained, as deficiencies in any of these items will be made apparent by the

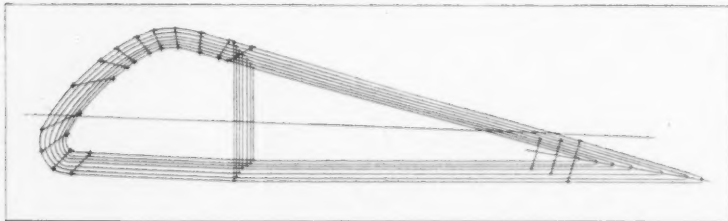
high rates of feeds and speeds which are employed, and the accuracy of the work will be affected. Likewise, faulty alignment of the machine elements will introduce errors which are beyond the control of the punched tape so that the potential accuracy of the system will not be realized.

A series of acceptance tests was carried out to determine the accuracy and dependability of the machine, and then the batch production of a small number of bulkhead fittings for an aircraft was attempted. A tape was prepared, and in order that corrections could be made, the portions for controlling the various operation stages were separated by 4-ft. blank lengths. Consequently, if there was an error at a particular stage, a portion of the tape could be removed and a corrected length substituted. In this manner, the need for re-typing the entire tape was avoided, and although the blank portions of the tape had the effect of returning the machine spindle to the datum point at the end of each operation stage, the accumulation of this unproductive time was still less than that which would have been required to repeat the entire machining operation. As a result of the experience gained on this component, the final tape incorporated spindle speeds and feed rates which, in most cases, were 100 per cent greater than were originally specified, and the rough machining operation was completed in 25 per cent of the time taken by conventional methods.

Here, a further instance may be quoted of the reduction in the time required to produce a particular part, which can be obtained with a tape-controlled machine. The chart in Fig. 2 compares the times taken for producing the aileron templates shown in Fig. 3, by conventional and tape-controlled methods, the major saving arising from the fact that the formulae for the master lines can be expressed in numerical code and included directly in the control tape.

If the full benefits are to be obtained from numerical control of machines, managements must be prepared to undertake major reorganizations on the lines here indicated, and to ensure that all those who will be engaged in the work of planning and machine operation are suitably trained.

Fig. 3. A Set of Aileron Templates Produced on the Machine Shown in Fig. 1, to which the Chart in Fig. 2 Relates



Use of Electric Clutches and Brakes to Safeguard Machines

By W. E. TIMMCKE*

With machines operating at higher speeds, and performing more functions automatically, it becomes increasingly important to provide adequate protection against incorrect motion sequences, or machine damage from other causes. On machines equipped with electrically-operated transmissions, it is a simple matter to wire the controls so that damage will not be caused in the event of incorrect functioning. The Warner Electric Brake & Clutch Co., Beloit, Wis., U.S.A., have co-operated with many machinery builders to equip machines with clutches, brakes and a combination clutch-brake unit, which fulfil a safety function in addition to transmitting power.

One such firm is the Ferguson Machine & Tool Co., St. Louis, Mo., makers of rotary transfer machines for automatic assembly. This company builds the Intermittor, high-speed, precision table shown in Fig. 1, which is capable of as many as

* Warner Electric Brake & Clutch Co., U.S.A.

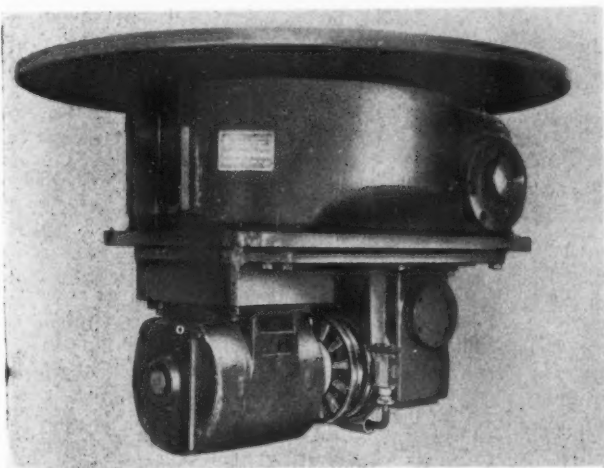


Fig. 1. A High-speed Indexing Table with a Standard Power Assembly. A Magnetic Clutch-brake Unit is Provided Between the Motor at the Left and the Gear-reduction Unit at the Right

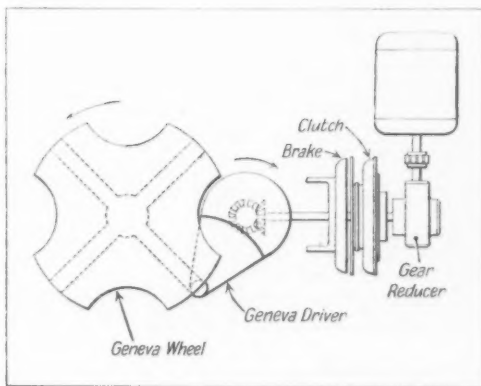


Fig. 2. A Combination Clutch-brake Unit is Here Used to Control the Rotation of a Geneva Drive

30,000 indexing motions per hour. A standard power assembly for the Intermittor, known as the Vari-Dwell, incorporates a motor, Warner clutch-brake unit, and speed reducer.

By reason of its virtually instantaneous engagement and disengagement, the clutch-brake unit synchronizes the movements of the tooling with the intermittent motion of the indexing-table. In addition, it permits control of dwell time while maintaining minimum indexing time. The safety features made possible by the clutch-brake are also important. For example, when electrical interlocks are used, the tools and dial can be stopped if the movements fail to synchronize. An electrical malfunction detection system can be used to reverse the clutch-brake action, in order to provide for automatic emergency stops. A manually-controlled emergency stop will also

interrupt the rotation of the dial, and the tool movements, by reversing the setting of the clutch brake. In addition, output torque can be regulated, by rheostat control of the clutch, to prevent tool damage if jamming should occur.

Another unit equipped with a Warner clutch-brake is the Ringmaster automatic assembly machine which places rings on motor vehicle pistons. Made by the Douglas Tool Co., Hazel Park, Mich., this machine incorporates an electric clutch-brake in the indexing drive to the worktable, which provides a means of electrically interlocking the cycle, in order to prevent damage due to jamming.

Limit switches operate the clutch-brake if there is any tendency for the work to jam, so that the clutch is disengaged, and the brake engaged to stop the machine before any damage can result. The machine has a magazine feed, and operates on a fully automatic cycle. A total of 1,800 piston-and-ring assemblies can be completed per hour at 80 per cent efficiency.

The clutch-brake is located on the output shaft of a speed reducer, as seen in Fig. 2, to control the rotation of a Geneva driver. Push-button control has reduced the time and cost of setting up, since it is possible to "inch" the machine without danger of jamming.

A different safety function is performed by a

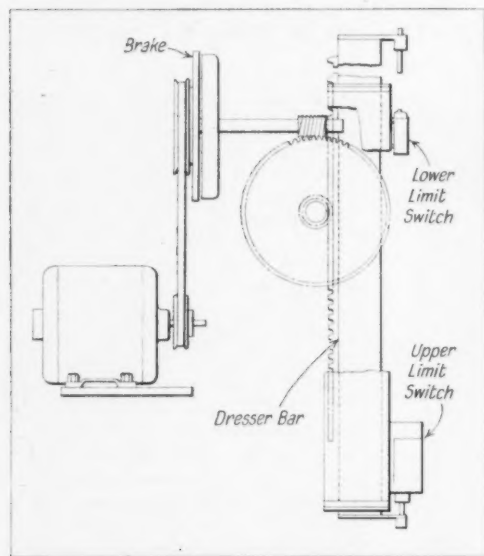


Fig. 3. This Magnetic Brake and Limit Switch Arrangement Controls the Travel of the Dresser Bar on a Duplex Disc Grinding Machine

Warner brake used on a duplex disc grinding machine built by the Gardner Machine Co., Beloit, Wis. This machine has been designed primarily for grinding two opposed surfaces on a part at one operation. It also may be used to grind a single surface of each of two opposed parts.

Referring to Fig. 3, the brake on this machine stops the dresser bar drive, at the end of the return stroke. The dresser bar is guided in a rigid bracket, bolted to the hood of the machine, and is traversed between, and parallel to, the faces of the wheels.

The brake incorporated in the transmission is energized by a normally-open limit switch, which is actuated by a dog when the dresser bar returns to rest position. In operation, the "dresser in" button is depressed, and the motor is started to traverse the bar towards the centres of the wheels. At the farthest point of travel, a dog engages a limit switch, and the motor is reversed. At the end of the return travel, a dog engages another limit switch to stop the motor and apply the brake.

HYPALON-COATED NYLON TEMPORARY STRUCTURES.—Air-supported buildings are now being used by several companies in the U.S.A., as portable temporary warehouses. One such building, erected by E. I. du Pont de Nemours & Co., Wilmington 98, Del., consists of a hemispherical "bubble" of Nylon, coated on both sides with Hypalon synthetic rubber, and measures 80 ft. in diameter. The coated fabric is weather- and waterproof, but is sufficiently translucent to permit natural lighting by daylight.

The strong, thin, light-weight material is held erect and stable by maintaining the interior at a pressure above atmospheric. A centrifugal blower, driven by a 1-h.p. motor, delivers up to 6,600 cu. ft. of air per min. for inflation, ventilation, and to make good any normal losses at the base or doors of the building. In the event of a power failure, it is claimed that the structure will remain inflated for several hours. Even if the building becomes completely deflated, the stored products are completely protected, due to positive anchorage of the base to the ground, and, on account of its light weight, the material will not damage the contents.

Inflated buildings may be anchored by various methods, including the use of sandbags, water-filled tubes, or eye-bolts. Specially-designed doors provide for the entry of fork-lift trucks and workpeople without loss of internal pressure. It is claimed that the buildings will withstand winds with velocities up to 70 m.p.h., and when they are no longer required at one site, they can be deflated and erected elsewhere.

Piercing Operation Performed on a Roll-forming Line

Cooling efficiency on a vehicle is increased by enclosing the fan in a shroud. If the shroud is not sufficiently stiff, a pulsating or drumming sound may be set up. To enable the requirements to be met, a new method of producing shrouds is now employed in the sheet-metal factory of Buick Motor Division, General Motors Corporation, U.S.A.

A circular fan shroud is required, with three channels in the cross-section. These integral channels have right-angle walls and impart the necessary stiffness, although the metal is only 0.0345 in. thick. The part is roll-formed from coil stock $6\frac{1}{8}$ -in. wide, and then formed to a circular shape, the ends finally being welded together.

To provide tabs on one end of each length, for welding, a piercing operation is carried out on the

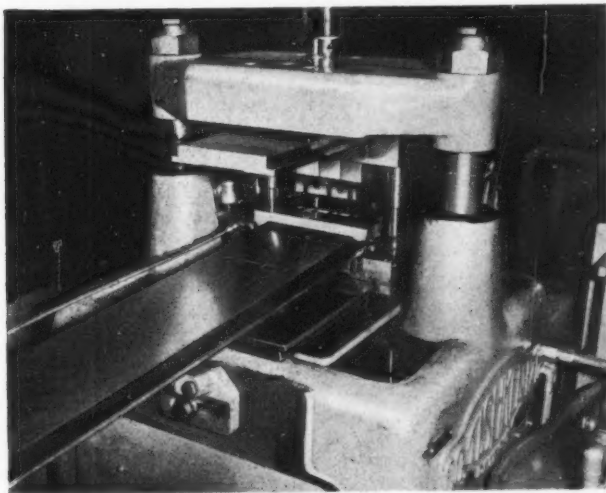


Fig. 1. A Row of Slots has Just Been Pierced in the Strip, and the Punches and Die-block are being Retracted on Their Slides

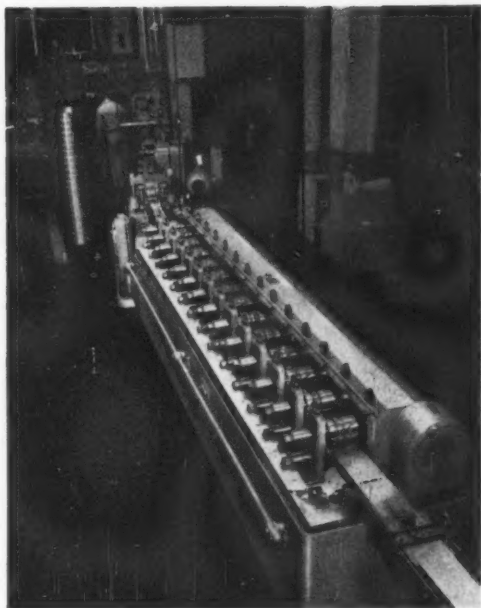


Fig. 2. The Integral Stiffeners in the Shroud Section are Roll-formed on this 14-stand Machine

line. For this purpose, the stock is passed through a "flying" punch press, between the coil cradle and the roll-forming machine, as may be seen in Fig. 1. Four punches, operating simultaneously, pierce a row of oblong holes across the strip. These holes are in areas in which the channels are subsequently formed in the strip. Piercing also facilitates the cutting-off operation, which would otherwise be complicated by the fact that the channel walls are at right-angles.

Rows of slots are pierced at a centre distance equal to the circumference of the shroud. Later, when the strip emerges from the forming machine, the flying shear severs it across each row of slots. Consequently, it is only necessary to cut the flat, un-formed portions of the strip.

As each row is pierced, it serves to locate the position on the strip at which the next row is required.

The positioning arrangement can be seen in the foreground of the view of the roll-forming machine in Fig. 2. In approaching the machine, the strip moves over an extension table, on which is mounted a sliding block. Pilots on the bottom of the block drop into the row of slots as the strip advances. A tie-rod on each side of the block connects it to the die set in the punch press (Fig. 1).

The punches and die-block are thus advanced on slides at the same speed as the strip, and at a spacing from the previous row of slots controlled by the tie-rods, until a cam in the press causes the punches to pierce the slots. Next, the pilots are automatically lifted from the preceding row of slots, and the punch and die-block are rapidly retracted on their slides.

For forming the channels in the strip, the

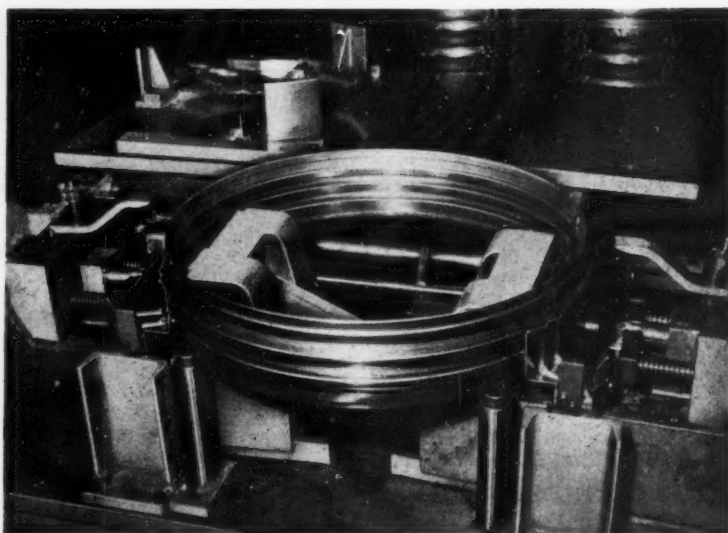


Fig. 4. Hydraulically-operated Punches Pierce Holes in the Welded Assembly. The Checking Fixture may be Seen in the Background

machine, built by Tishken, has 14 roll stands. Lengths are cut off by the flying shear, and continue to move forward along a track to a roll-forming machine, shown in Fig. 3, on which the circular shape is produced.

The ends of the shroud are then butted together and spot-welded in the tab areas, and mounting brackets are subsequently spot-welded at the diametrically opposite points. Finally, a hole is pierced through the shroud, at each of the bracket positions, on the Mid-West Hydro-Pierce machine, seen in Fig. 4.

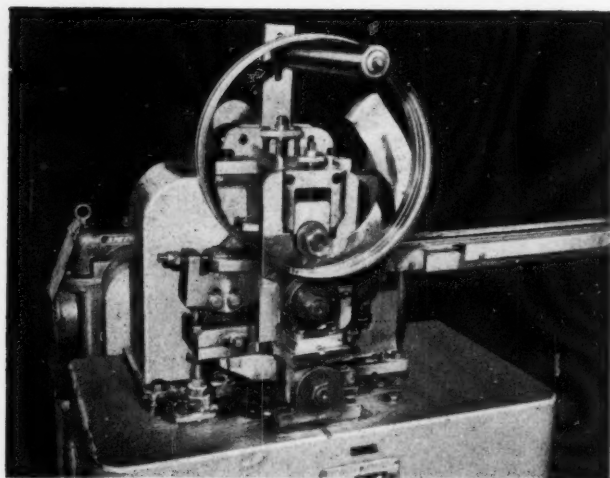


Fig. 3. The Shroud Strips are Formed to the Required Circular Shape on this Machine

DIESEL AND DIESEL-ELECTRIC LOCOMOTIVES, of less than 275 h.p., produced by British Railways and private manufacturers, for use on main line railways in the United Kingdom, totalled 8 and 9 respectively during the first and second quarters of 1957. Similar types of locomotives produced for export, during the same periods, totalled 97 and 100. Diesel and diesel-electric locomotives of more than 275 h.p., produced during these periods for use in the United Kingdom, totalled 12 and 33, and for export, 18 and 19 respectively.

Jameson Horizontal Travelling-column Milling and Boring Machine

The horizontal, travelling-column, milling and boring machine shown in Fig. 1 has recently been designed and built by J. L. Jameson, Ltd., Ewell, Surrey, and supplied to J. & E. Hall, Ltd., Dartford, Kent. This machine, which is known as the VA type, was erected at the maker's No. 2 works, Mount Road, Chessington, and is shown set up for acceptance trials, during which a 7- by 5½-in. Veebloc compressor crankcase was face-milled with a 20-in. diameter inserted-tooth carbide-tipped cutter. The crankcase is mounted on an air-operated indexing fixture, which, in turn, is carried on the hydraulically-operated 4-station indexing table, seen bolted to the main table of the machine. This latter table is tenoned to the main machine bed, and has a working surface of 51½ by 108 in.

SPINDLE HEAD

The spindle has a B.S. 50 series nose, and is mounted on ball and roller bearings inside an 8½-in. diameter cast-iron quill. Axial forces are carried by a Hoffman double-row heavy-duty thrust race. The quill has a traverse movement of 8½ in., and this adjustment is obtained, by hand, through a worm and rack reduction. A large-diameter collar mounted on the hand-wheel for controlling this movement is graduated in 0.001-in. divisions, and a lever-operated clamp, in the spindle housing nose, serves to lock the quill in the required position.

There are 18 spindle speeds, ranging from 8 to 440 r.p.m., these speeds being selected by levers on the front of the spindle head. A flange-mounted 15-h.p. squirrel-cage motor is direct-

coupled to the first gear shaft, and a duplex multi-disc clutch and brake serves to transmit the drive. Cascade lubrication for all the gears and bearings in the spindle head is provided by a gear pump, which is continuously driven from the constant speed clutch shaft, and a separate supply of oil is directed on to the clutch plates. A sight-glass, on top of the spindle head casting, gives a visual indication that the oil is circulating.

Hand adjustment of the spindle head, on the column ways, is obtained from a star-wheel which, through spiral gears, rotates the traversing nut around the vertical screw. This mechanism is locked when the screw is being power driven for traversing the head. A vertical traverse movement of 60 in. is obtainable, and the minimum distance from the spindle centre to the working surface of the indexing table is 4 in.

A vertical, grooved bar, supported on the column saddle, and located by a bracket on top of the column, carries measuring standards and a direct-

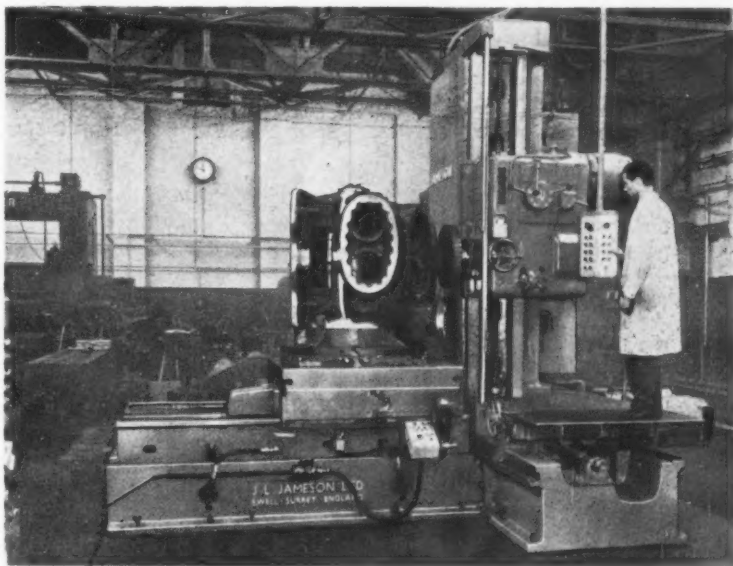


Fig. 1. Jameson VA-Type Horizontal Travelling-column Milling and Boring Machine Shown Set-up for Face-milling a Compressor Crankcase

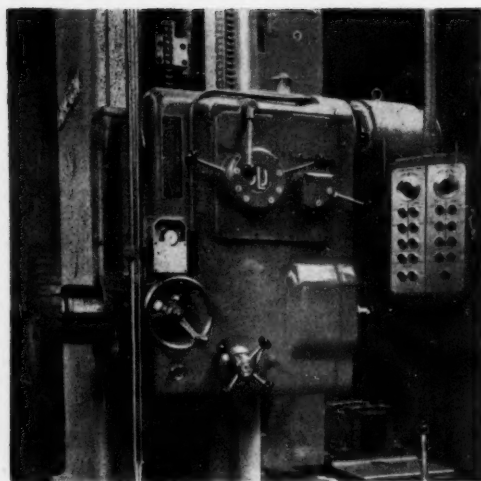


Fig. 2. Close-up View of the Spindle Head and Pendant Control of the Machine Shown in Fig. 1. The 9-position Rotary Switches for Selecting Horizontal and Vertical Feed Rates can be Seen at the Top of the Pendant

reading scale, and a dial indicator and cursor are mounted on the front of the spindle head, as can be seen in the close-up view, Fig. 2. The spindle head is balanced by a counterweight, which is suspended inside the column on twin roller chains.

HORIZONTAL AND VERTICAL FEEDS

Nine feed rates, ranging from 1 to 20 in. per min., are available in both the horizontal and vertical directions, and a rapid traverse rate of 60 in. per min. is, likewise, common to both movements. Two, separate, constant-mesh gearboxes, housed in the column saddle, provide for these movements, and speed changing is effected by Siemens-Schuckert electro-magnetic multi-disc clutches. Each clutch is provided with two current supply brushes, one of which is unconnected, electrically, and acts as a wiper for the clutch slipping.

Both gearboxes are driven by 4-speed pole-changing motors, the horizontal feed motor developing 7 h.p. at top speed, and the vertical feed motor, 1.2 h.p. The output shaft of the horizontal feed gearbox is direct-coupled to a worm, which meshes with a wormwheel bolted to the traverse nut, and the latter is thus rotated around a fixed screw in the throat of the main

machine bed. Horizontal traverse can also be applied manually, by the hand-wheel seen at the front of the column saddle in Fig. 1. Drive from the vertical feed gearbox is transmitted by a worm and wheel unit, which is direct-coupled to the bottom of the vertical screw.

The required feed rate is selected by means of 9-position rotary switches, which can be seen at the top of the pendant control in the close-up view, Fig. 2. Each switch has a dial on which the rates of feed are marked in inches per min., and the pre-selection of a particular feed rate sets up an electrical circuit through the required clutches, and for the appropriate motor speed. The circuit is completed by pressing the associated traverse button, whereon the clutches are energized and the motor is started. Horizontal and vertical feeds can be set independently of each other, and the rates of feed can be changed while machining is in progress. The pendant control includes push-buttons for "inching" both these motions.

Rapid traverse buttons are provided for the vertical and horizontal movements, in both directions, and when these buttons are depressed the top speed of the appropriate motor is selected, and traverse button, whereon the clutches are energized. Rapid traverse rate is maintained only while the button is depressed, and automatically cancels any feed motion that may have been selected previously. The electrical control gear is carried in a cabinet bolted to the column, and mains current is supplied from a spring-powered cable reel attached to the machine bed, at the rear.

COLUMN SADDLE

The column saddle is a robust casting, with strong box-ribbing, and contains a built-in oil sump for lubricating the two feed gearboxes, and the slideways. This casting is guided on the front shear of the main bed, and adjustment is provided by two, long, tapered gibs—one at each end of the saddle. The traversing nut and wormwheel, for the horizontal movement, is carried in an oil-bath housing bolted to the under-side of the saddle casting, and the design of the bed is such that this housing can be removed as one piece. A dial indicator is mounted on the end of the column saddle, and is operated by means of a vertical rod and lever. This lever contacts measuring standards carried in a V-grooved bar attached to the front of the machine bed. A direct reading scale is also attached to this bar.

For locking the column saddle to the machine bed, there are two widely spaced clamps, which are applied by a single operating lever, and this

mechanism is interlocked with the horizontal traverse motor so that the latter cannot be run when the saddle is clamped.

FOUR-POSITION INDEXING BORING TABLE

The indexing table is 54 in. square, and is pivoted on a saddle which can be traversed through a distance of 48 in., by means of a piston working in a 5-in. diameter double-acting hydraulic cylinder. Movement of the saddle, which is used when boring, is steplessly-variable from 0.1 to 2 in. per min., and a rapid traverse rate of 80 in. per min. is available. A limit switch, operated by an adjustable cam on the sliding saddle, stops the feed movement, and permits shoulder-boring to be carried out to an accuracy of 0.001 in. The indexing table has a T-slotted working surface, and a hand-operated indexing plunger

engages hardened and lapped bushes in the underside of the table.

A hydraulic cylinder, beneath the centre of this table, raises it clear of the saddle for rotation, and, when indexing has been completed, the table is clamped to the saddle at each corner. The push-button control panel and hydraulic feed-rate control are located adjacent to the main machine bed, and a swivelling pendant, on which the electric controls are duplicated, can be fitted if required. This indexing and traversing table is a self-contained unit, with its own hydraulic assembly and electrical control gear, and may be removed from the worktable and used separately.

J. L. Jameson, Ltd., are also engaged in the design and construction of a special purpose 3-head boring machine, for J. & E. Hall, Ltd., for operations on their range of gate valves, and it is hoped to publish details of this machine in due course.

Arrangement for Changing Cam Timing while a Machine is Running

By W. M. FOSTER

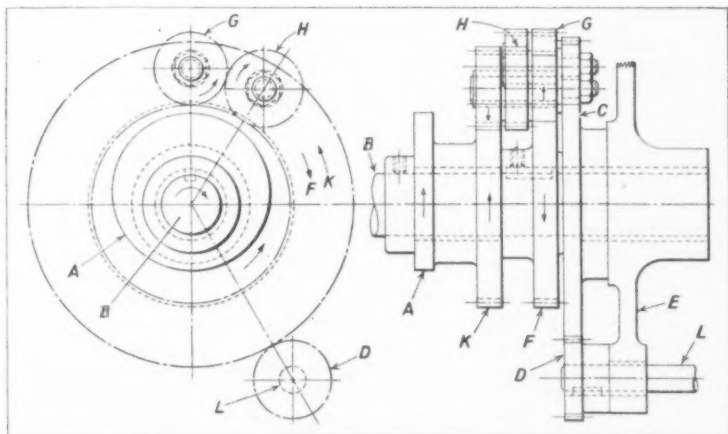
On a machine employed in the paper-converting industry, it was necessary to provide a means of changing the timing of a rotating cam. On account of backlash and deflections which occur in operation, and variations in the material to be processed, accurate timing could not be obtained with the machine stationary. In the figure is shown the mechanism provided for changing the timing while the cam is rotating.

The cam *A* is supported by, but is free to rotate on, the input shaft *B*. A planet carrier *C*, which is also freely mounted on the input shaft, is normally locked against turning by engagement with the pinion *D*, carried by stationary bracket *E*. The gear *F*, however, is keyed to the input shaft.

Two studs on the planet carrier support

the long pinions *G* and *H*. One-half of the pinion *G* meshes with the gear *F*, and the other half meshes with one-half of pinion *H*. The other half of the pinion *H*, in turn, meshes with the gear *K*, which is integral with the cam.

The gears *F* and *K* are of the same size, as are the pinions *G* and *H*. As a result, when the input shaft and gear *F* rotate, the gear *K* is driven at the same speed, but in the opposite direction, as is required.



This Gear Train Enables the Timing of a Cam to be changed while the Machine is Running

New Jones Type KL 10-6 Mobile Crane

The range of Jones mobile cranes, built by K. & L. Steelfounders & Ironfounders, Ltd., Letchworth, Herts., has been extended to include the KL 10-6, which is here shown, lifting a crane of a different type on to a low-loading articulated road vehicle.

The KL 10-6 can be fitted with strut-type jibs of lattice construction in lengths of 30, 40, 50, 60, and 70 ft., and maximum heights of lift from 26 to 64 ft. above ground level, are thus obtainable. Jibs of swan-neck and other designs can be supplied to order. Loads up to 6 tons can be handled at a radius of 10 ft., with a 30-ft. jib, and, when retractable screw-type outriggers at the corners of the chassis are brought into use, as shown, a maximum weight of 10 tons can be lifted.

Lowering of the load is controlled by means of a centrifugal brake. Alternatively, an engine-controlled unit can be provided which permits of lowering and "inching" with a high degree of sensitivity. With this equipment, while the load is being lowered, the winch barrel is automatically coupled, by a free-wheel arrangement and gearing, to the 35-h.p. diesel engine of the crane, so that the rate of movement is restricted by the engine speed. The free-wheel arrangement is such that, when the winch barrel is rotated in the opposite direction, the normal drive is engaged.

From the engine, the main drive is taken through a 3-speed gearbox and a triplex roller chain, and thence, by separate dry-plate clutches and gearing, to the derrick, slewing, hoisting, and travelling motions, which can be operated separately or together, as required. The road wheels are driven through a 4-wheel differential unit, and they are of the restrictor type, with flanges slightly smaller in diameter than the tyres, so that deflection is reduced under heavy loading conditions. In the event of sudden tyre deflation, moreover, there is no risk of the crane tipping. Steering, which



The New Jones KL 10-6 Mobile Crane Lifting a Small Crane on to a Low-loading Vehicle

is power-assisted progressively, is normally applied to two wheels, but for use in confined spaces, steering mechanism to operate on all wheels can be fitted.

Chassis of a number of different types, for road and railway use, can be supplied, and equipment available includes lifting magnets, grabs up to 34/27 cu. ft. capacity, and a safe load indicator which provides audible and visual signals.

Sales of Jones cranes are handled in this country by George Cohen, Sons & Co., Ltd., Wood Lane, London, W.12.

"SAFETY WALK" NON-SLIP FLOOR COATING which has been introduced, for use in factories and workshops, by the Minnesota Mining & Manufacturing Co., Ltd., 3M House, Wigmore Street, London, W.1, consists of tough fabric, surface coated with hard mineral grains. It is supplied in the form of cleats, strips, and rolls, and is said to be unaffected by petrol, oil, or moisture. Types A and B are self-adhesive and can be applied to various surfaces, including concrete, tiles, steel plates and wood. Type D is non-sparking, and can be used in situations where there is risk of explosion or fire.

Production of Herbert-DeVlieg Type 2 B-36 Jigmils

Alfred Herbert, Ltd., Coventry, who have acted as sole distributors in this country, since 1947, for the Spiramatic Jigmils, developed by the DeVlieg Machine Co., U.S.A., have recently started to build under licence at their Lutterworth works, the smallest machine in the range. The British-built Jigmil is known as the Herbert-DeVlieg Spiramatic 2 B-36, and the first production machine of its type is shown in Fig. 1.

TYPE 2 B-36 JIGMIL

Although the advantages afforded by the DeVlieg Jigmils for performing precision boring and milling operations without the use of jigs are well known, reference will here be made to some features of the design. The type 2 B-36 machine is equipped with a 36- by 24-in. T-slotted work table, which has a cross travel of 12 in., and the movement of the saddle on the bedways is 36 in., and of the spindle head on the column ways, 24 in. The machine is stated to have a general assembly accuracy of 0.0001 in. per foot, and co-ordinate settings of the saddle and spindle head are obtained automatically by a patent electrical system in conjunction with end measuring bars and dial indicators. With this system, when settings have been made, the traversing screws are automatically reversed for releasing end thrust. The saddle and spindle head can then be secured to the guideways by hand-operated clamps without risk of disturbing the settings. Alternatively, the patent Duplital system can be used in conjunction with the automatic positioning arrangement to facilitate setting the table and spindle head when workpieces are to be handled in batches. Sixteen feeds for milling, from 0.4 to 32 in. per min., can be applied to the saddle and spindle head, and rapid power traverses at the rate of 50 and 150 in. per min. are obtainable by partial or full depression of a push button. The cross-traverse movement of the table is driven by an independent motor, and enables the table to be positioned close to the spindle to reduce overhang of the cutting tool, and withdrawn to facilitate inspection and tool changing. Micrometer adjustment is provided for controlling the movement of the table towards the spindle.

Of 2½ in. diameter, the spindle has an axial

travel of 12 in., and six boring feeds from 0.0016 to 0.018 in. per rev. are obtainable. Drive is taken from a 5-h.p. motor, through silent, constant-mesh, helical gears, which give 16 spindle speeds ranging from 42 to 2,000 r.p.m. Alternatively, spindle speeds from 50 to 2,400 r.p.m. can be provided. The spindle speeds are selected by a dial on the head, and they are brought into use by means of a lever. Movement of this lever causes the spindle to be driven at a slow speed for a short period to ensure full engagement of the dog clutches in the headstock, and the pre-selected spindle speed is then automatically brought into use.

Dials and verniers are provided to facilitate setting the spindle travel, and an indexing turret attachment fitted with adjustable stops, and a trip mechanism, are available for use when holes are to be bored to predetermined depths and counter-boring is to be carried out on a batch-production basis. A motor-driven draw bar is incorporated which is brought into use by means of push buttons and enables cutting tools to be held in the taper bore at the nose end of the spindle under a constant load. With this feature, tool changing is facili-

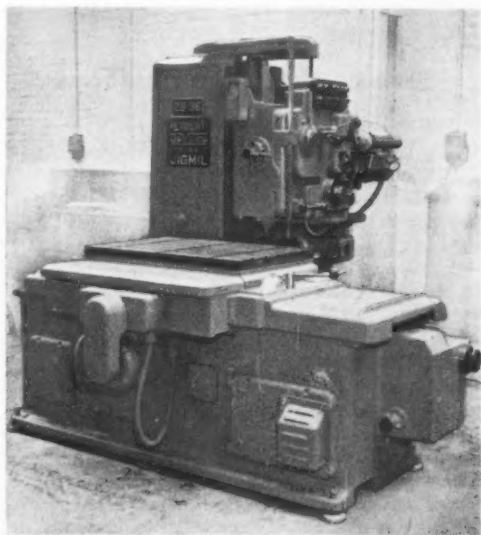


Fig. 1. Herbert-DeVlieg Spiramatic 2 B-36 Jigmil



Fig. 2. A View of Part of the Assembly Department for Herbert-DeVlieg Jigmils at the Lutterworth Works. During Assembly, Each Machine Rests on an Insulated Concrete Platform

tated, and the risk of variations in endwise settings of cutters is obviated.

Jigmils built in the U.S.A., and distributed in this country by Alfred Herbert, Ltd., are available with 3- and 4-in. diameter spindles, and have longitudinal saddle movements from 48 to 120 in., and vertical spindle head traverse lengths which range from 36 to 72 in.

PRODUCTION FACILITIES AT LUTTERWORTH

For the production of Jigmills, the Lutterworth works have been extended to provide additional floor space amounting to 16,470 sq. ft. At present the machines are being built at the rate of three per month, although provision has been made for double that output.

In that portion of the new extension devoted to the assembly department, a view of which is given in Fig. 2, the floor comprises a number of 12-in. thick concrete platforms, arranged in rows with a central gangway between them. Each platform is supported by 9 reinforced concrete piers which extend for a depth of 7 ft., and is insulated from the surrounding floor by cork strips. During assembly operations, each machine is supported by a separate platform which ensures the necessary freedom from vibration to enable accurate tests for alignment and setting to be carried out.

A large capacity oil-fired stress relieving furnace,

supplied by Gibbons Bros., Ltd., Dudley, is installed in a separate shop for treatment of all castings for Jigmils. These castings, it may be noted, are produced in the company's foundry at Coventry. For stress relieving, the furnace is brought to a temperature of 600 deg. F., and the castings are then loaded. The furnace temperature is next increased at the rate of 50 deg. F. per hour for 9 hours, and is held at the maximum (1,050 deg. F.) for a period of 5 hours. The temperature is then progressively reduced to 600 deg. F. during the next 9-hour period. Certain castings, on which machining is performed

over a large part of the surface areas, are subsequently subjected to an additional stress relieving treatment. One such component forms the upper part of a 4-position indexing work table, which is available as an additional attachment for the machine.

New equipment installed in the machine shop adjacent to the assembly department includes a Swift Summerskill 12-ft. stroke planer, a Waldrich-Siegen (Alfred Herbert Ltd.) 10-ft. stroke planer, and an Archdale 5-ft. radial drilling machine, also a type 4 B-60 and a type 2 B-36 Jigmil.

Of exceptionally robust construction, the Waldrich-Siegen planer is employed for all finish planing operations on the beds, columns, work tables and indexing tables for Jigmils, and the accuracy obtained is such that little hand scraping is subsequently required. A substantial cross member, housed in a pit in the shop floor, supports the columns of the planer and the portion of the bed beneath the cross rail, so that exceptional rigidity is obtained at the cutting point.

In the close-up view in Fig. 3, four upper portions for indexing table attachments are seen mounted on the table of the planer, which is set up for machining five T-slots simultaneously. The slots are held to a high degree of accuracy for width and parallelism with the edges of the table attachments, and machining is carried out on the narrow portions by Ardoloy button-type tools

which are mounted in a special holder attached to one of the tool boxes on the cross rail. A feature of the machine is that the tool slide is moved upwards in guideways at the end of the cutting stroke of the table by a built-in motor drive arrangement, so that the tools are brought clear of the slots in the work during the return movement.

Boring operations on all castings are carried out on the Jigmils, and the need for jigs is thus entirely eliminated. The feed gearbox is made in two parts which are bored separately and then bolted together. As an example of the accuracy obtainable on the Jigmil, it may be noted that the holes to take dowels for locating the halves of the gear box are bored in each part separately at the same set-up at which other bores are machined.

A 1½-in. capacity horizontal spindle drilling

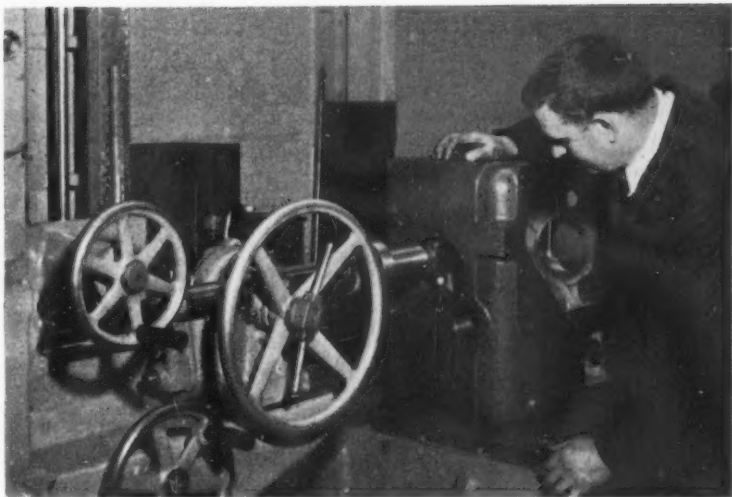


Fig. 4. A Close-up View of the Herbert Horizontal-Spindle Drilling Machine Equipped with a Right-angle Spindle Attachment for the Production of an Oil Hole in a Main Bearing Bore

machine, built by the company, is installed for operations on the end surfaces of bed and column castings, for example. Of similar type to that employed on the Herbert BB vertical-spindle drilling machine, the spindle head can be traversed for a distance of 36 in. on the column, and the latter has cross adjustment on a short bed mounted on the shop floor. A fixed T-slotted work table is supported by concrete pillars on the shop floor. A right-angle spindle attachment has been designed for use with this machine, to facilitate drilling cross holes in internal surfaces and webs of various castings. This attachment is seen in position in the close-up view, Fig. 4, which shows a set-up for drilling an oil hole in a bore which accommodates one of the main bearings in the spindle head.

Upon completion of

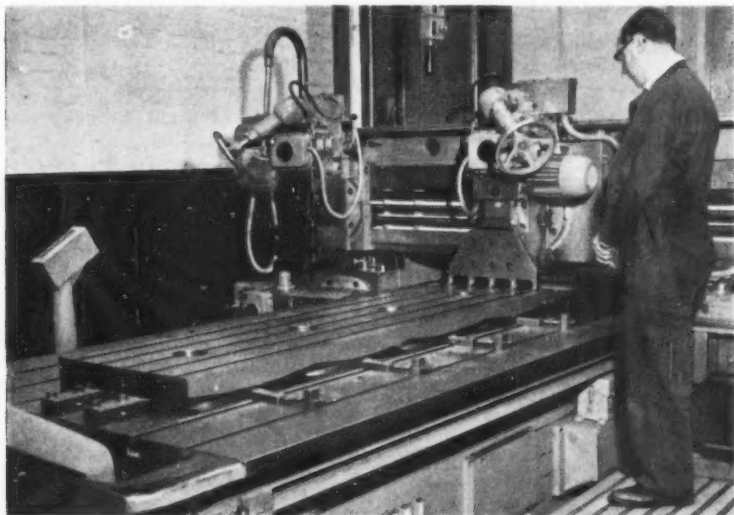


Fig. 3. Close-up View of the Waldrich-Siegen Planer Set Up for Machining T-slots in Indexing Table Attachments

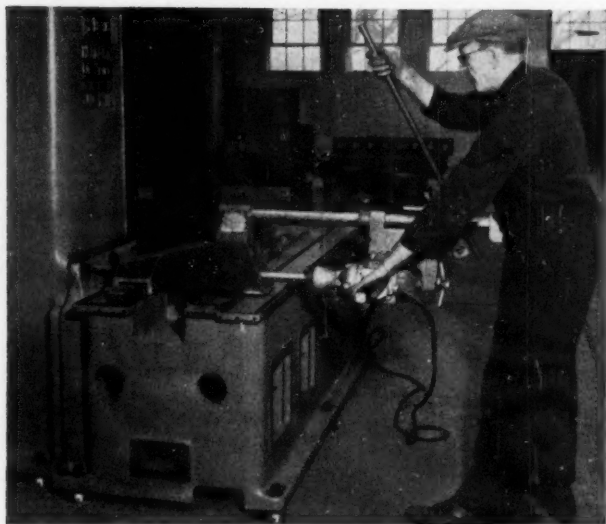


Fig. 5. This Portable Rig is Used for Drilling and Reaming Dowel Holes in the Column and Base when they have been Set for Squareness

the machining operations and hand scraping of the guideways, the column and bed are bolted together, and are then set for squareness in both directions by means of a large-diameter cylindrical square and a dial indicator mounted on an attachment which can be traversed by hand on the column ways. When settings for squareness have been made, dowel holes in the column and bed are drilled and reamed with the aid of the rig illustrated in Fig. 5. This equipment may be secured to the bedways, as shown, or mounted on the shop floor for drilling and reaming dowel holes in side flanges on the column. It incorporates a large capacity portable electric drill, which has an extension spindle and can be traversed on a cylindrical guide bar by movement of a long lever.

All gears for the Herbert-DeVlieg Jigmil are cut on a Fellows-England No. 7125A gear shaper, and subsequent treatment is carried out with induction heating equipment. Finishing operations on the majority of the gears are then carried out on a Churchill Redman shaver, and a Taylor-Hobson lead measuring machine, fitted with a recording unit, is provided for checking helix angles. Sub-zero cooling equipment and a hot oil bath have been installed for the preparation of certain mating parts, to enable them to be assembled with interference fits.

Electrical equipment for controlling the various motions of the Jigmil is housed in a self-contained cabinet, which is attached to the rear of the column, and a special unit has been built by the company for testing the equipment before it is installed on the machine. This unit incorporates push buttons and switches, which correspond to those on the machine, and, when they are operated, cause different parts of the electrical system to be brought into use.

Part of the new extension at the Lutterworth works is devoted to the production of Microbore adjustable single point cutting tools, which, it may be recalled, were originally developed for performing precision boring operations on DeVlieg Jigmil machines. An improved machining sequence has now been adopted for producing the adjustable cartridges for these cutters to which Ardolov tips are secured by brazing. With this sequence, threads are rolled on the shank of the cartridge after completion of tip-brazing and other

operations. A new grinder, recently developed by the DeVlieg Machine Co., will shortly be installed, which will enable the flank angles and nose radius of an Ardolov tip to be ground at a single continuous operation.

Trade Publications

HADFIELDS, LTD., East Hecla Works, Sheffield, 9.—Folder entitled "Cut Your Machining Costs by Using Precision Castings," in which particulars are given of some accurate castings produced by the investment method, shell moulding, and certain specialized processes.

U.D. ENGINEERING CO., LTD., Cumberland Avenue, Park Royal, London, N.W.10. Booklet of 12 pages devoted to the company's activities in the field of industrial refrigeration. Various types of machinery are described and illustrated, and some representative installations are shown.

DUNLOP RUBBER CO., LTD., St. James's House, St. James's Street, London, S.W.1. Publication devoted to Dunclad chemical plant linings, issued by the General Rubber Goods Division. Information is included on the available materials, their properties, and application.

LONDEX, LTD., Anerley Works, 207 Anerley Road, London, S.E.20, have issued a data book entitled "21 years of progress" on the occasion of the 21st anniversary of the company. Following a brief history of the business, separate sections are devoted to relays, special apparatus, timers, and fluid and gas control. An index is provided.

News of the Industry

Manchester and District

THOMAS RYDER & SON, LTD., Turner Bridge, Bolton, are experiencing a good demand for their No. 6 and No. 8 Verticalautos, with six spindles. In addition, several No. 10 Verticalautos are on order, with six, eight or double-six spindles. The principal customers are in the motor car, motor vehicle and tractor industries, and the machines are required for operations on such components as hubs, differential cases and gears, brake drums, cylinder liners and flywheels. On export account we may note recent business with Italy and France. Multiple drilling, reaming and tapping heads are being applied to the machines to an increasing extent, for operations on brake drums and other components. A recent innovation is the provision of automatic loading on a No. 6 Verticalauto for machining differential bevel gears. Other orders cover Rydermatic No. 18 single-spindle vertical automatics, and universal machine tools for the Admiralty. The latter machine comprises a combined lathe, universal grinding machine, universal milling machine, and pillar drilling machine, and is intended for use on board ship.

PILOT WORKS, LTD., Manchester Road, Bolton, are busy on home and export orders for 15- and 12-ton hydraulic presses and No. 2 hydraulic cropping machines. The cropping machine will shear flat mild steel of 2- by $\frac{1}{2}$ -in., 3- by $\frac{3}{4}$ -in., and 4- by $\frac{1}{2}$ -in. section, also $\frac{1}{4}$ -in. thick plate of any width. A good business is also reported in the recently developed 3-ton hydraulic bench press, which was shown for the first time at the Engineering and Marine Exhibition, held at Olympia last September, and described in MACHINERY, 91/510—30/8/57. The latter machine, which is of fabricated steel construction, has an integral 2-gallon capacity oil tank and incorporates a Pilot combined twin-cylinder, plunger-type pump, with additional gear booster pump, fully

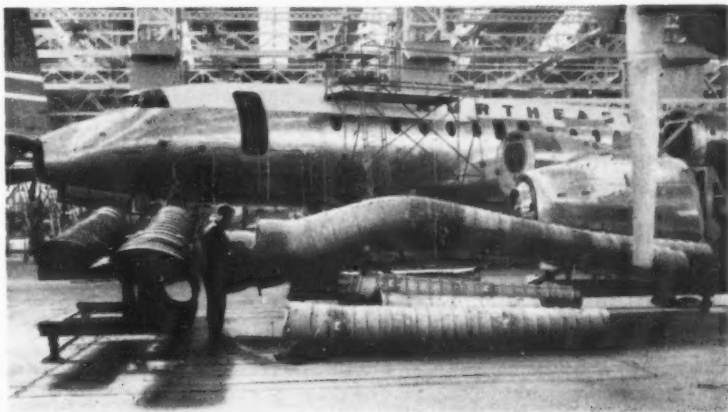
immersed in the oil tank. Overseas orders have recently been booked from Australia, India, Canada and various Continental countries.

NATIONAL GAS & OIL ENGINE CO., LTD., Ashton-under-Lyne, a Brush company in the Hawker-Siddeley group, have recently received an order, valued at £500,000, from the Argentine Government, for the provision of electric generating sets. These will be used mainly to provide emergency power in small towns and delivery will be completed this year. A similar order for equipment to the value of £500,000 was placed with the company last year.

ABRAMS ENGINEERING SYD ABRAMS, LTD., Waterloo Road, Cheetham Hill, Manchester, are well equipped for dealing with a large variety of sub-contract repetition machining and gear-cutting work. The plant includes centre lathes from 6- to 24-in. swing, admitting up to 80 in. between centres, and a Unicop copying lathe of 20-in. swing, admitting 70 in. between centres; turret and capstan lathes for chucking work up to 24 in.

* * *

These large exhaust shrouds for the Bristol Britannia airliner were produced by Joseph Lucas (Gas Turbine Equipment), Ltd., Burnley, from I.C.I. titanium sheet, by seam welding. For the outboard and inboard engines, the complete shrouds are 17 ft. 6 in. and 22 ft. 6 in. long by 4 ft. 6 in. diameter. The saving in weight obtained by using titanium instead of steel is 60 lb. for the outboard, and 66 lb. for the inboard shroud



diameter and admitting bars up to 5 in. diameter; single- and multi-spindle automatics up to 1½-in. bar capacity; grinding machines of the cylindrical, internal, universal, tool and cutter, and surface types; horizontal and vertical milling machines with maximum table capacity of 96 by 24 in.; horizontal boring machines, up to 36-in. table capacity; also facing, shaping, slotting, broaching, radial arm drilling, and single- and multi-spindle drilling and tapping machines.

In the gear-cutting department, a Gleason spiral bevel gear generating machine of 16-in. capacity has recently been added, and other machines are available for cutting straight and spiral spur gears up to 24 in. diameter, internal gears up to 20½-in. diameter, straight bevel gears up to 12 in. diameter, worms and worm-wheels, and racks, also for tooth rounding. Orders have recently been executed for gears and components for the Calder Hall Power station of the Atomic Energy Commission and for components employed in connection with the transfer of wire cables to drums. Partial or complete assembly of units and equipment is also undertaken, as well as machine tool reconditioning. A rolling mill is being developed, to which we hope to make further reference at a later date.

RENOLD CHAINS, LTD., Wythenshawe, Manchester, have recently issued a fully-illustrated brochure describing the use of Renold chains in the processing and packing of food, processing and bottling of drinks, and processing and packing of tobacco, also for packing and handling generally.

THOMAS ROBINSON & SON, LTD., Railway Works, Rochdale, were recently visited by a party of Czechoslovakian flour-milling experts, who were able to see a wide range of flour-milling machinery under construction, including the company's pneumatic roller mills of the type now being installed in new and re-equipped flour mills in various parts of the world.

GRAVEN BROTHERS (MANCHESTER), LTD., Reddish, Stockport, have recently built a 60-in. centre lathe, with auxiliary milling and grinding attachments, for power station maintenance work. It has been despatched to the Electricity Supply Commission—Rand Undertaking, South Africa, for installation in the new central maintenance workshop at Rosherville power station. Intended chiefly for checking the truth of large electrical rotors, and for carrying out light corrective operations on such components, the machine will also be used for general work of a light nature on shafting and large engine crankshafts, and for re-turning the journals and tyre treads of locomotive wheel sets. Rotors up to 60 tons in weight can be accommodated, and

work up to 8 ft. 6 in. diameter can be swung over the saddle, and lengths up to 45 ft. are admitted between centres. Drive to the headstock is taken from a 30-h.p. constant-speed motor, and 16 spindle speeds are available, from 1 to 50 r.p.m. We hope to describe this machine more fully at a later date.

H. B.

London and the South

DOWDING & DOLL, LTD., 346 Kensington High Street, W.14, are experiencing a sustained demand for many of the machine tools of British and Continental origin which they handle, and the sales of Dowding "Fast Cycling" injection moulding machines continue to expand. The new British-built Wiedemann R.44 turret punch press, which was shown at the recent machine tool exhibition at Hanover, where it aroused considerable interest, is now in production. This machine is designed for piercing through templates, but as an alternative a rack gauge table for hole location may be fitted. It is rated at 13½ tons and has a capacity for mild steel plate up to ¾ in. thick when the punch diameter does not exceed 1 ⅜ in. Punches up to 3 in. diameter can be used on thinner plate. Increasing sales are reported of the company's thread milling hobs, crushing rolls and chasers, which can be supplied in standard and special sizes.

J. C. NEVILLE, LTD., 34 Priests Bridge, S.W.14, who are agents for R.G. tube cutting and screwing machines and Barson cold sawing machines for metal, are very busy. The former, it is reported, are selling well in this country and in overseas markets. This company is now marketing a range of tube bending machines some of which have capacities for tubes up to 6 in. diameter.

J. HORNAL, Dower Road, Fulham, S.W.6, inform us that the Hornamill universal, self-contained milling head, which is distributed by their associates the Hornamill Machine Tool Co., Ltd., is now being exported. This milling head, which was described in MACHINERY, 89/585—7/9/56, can be fitted to horizontal milling machines with cylindrical overarms to enable vertical, angular and twin-spindle milling operations to be performed. Drive is taken from a motor through V-belts and pulleys to the spindle, which has six speeds ranging from 328 to 4,000 r.p.m. This firm is also engaged on contract work which at present includes the machining of batches of light alloy castings for enclosing gears and other parts of marine control apparatus. Among new machines which

have recently been installed in the works may be noted a 12½-h.p. Wadkin routing machine.

PRECISION PRODUCTS (ROMFORD), LTD., Viking Works, London Road, Romford, Essex, are engaged in the design and production of fixtures, form tools, press tools and gauges for many industries. Form grinding is extensively employed, and in this connection it may be noted that curved forms, including those of very small radii, are dressed on grinding wheels with the aid of Habit Radtan equipment. For finishing the bores of small holes down to 0.040 in. diameter, special diamond-impregnated mandrels, driven by a high-speed spindle, are used. The machine tools installed enable a wide range of operations to be carried out, and include three jig borers and several grinding machines.

M.A.X. DESIGNS, LTD., Avenue Works, Arterial Road, Gidea Park, Essex, report that the demand for their services is well maintained. Among other activities this company is engaged in the design of special tooling for a wide range of engineering applications.

CREATORS, LTD., Plaisel Works, Sheerwater, Woking, Surrey, are still fully occupied with orders for an extensive range of products made from nylon, PVC, polythene, polystyrene and other plastics. The processes employed include extrusion, injection moulding, slush and dip moulding, vacuum forming, and high-frequency welding. This company's industrial armoured piping, of translucent plastics with spiral wire reinforcement, finds extensive application for the delivery of lubricating and fuel oils, also acid and alkaline fluids. Gaiters and dust covers made from plastics, which will withstand prolonged exposure to temperatures ranging from 70 deg. C. down to -30 deg. C., are in demand from the machine tool and other industries. The works, with an area exceeding 20,000 sq. ft., are laid out for the manufacture of plastics products in batches or long runs. A consulting service for problems connected with plastics materials is provided by this company.

Recent additions to the range of products include coiled extending leads, which can be supplied with P.V.C. or nylon binding, and metallized plastics trim sections. The latter incorporate metal foils, which may be either plain or patterned, and are available in a wide variety of cross-sectional forms.

LETCHWORTH COMPONENTS, LTD., Works Road, Letchworth, Herts., are receiving numerous orders for their optical projectors which are available for bench or floor mounting. The Gazelle Major cabinet projector is now in production and sales

have already been made in export markets. It is reported that the bench type projector, introduced last year, is selling well.

GREEN & NICKELS, LTD., Works Road, Letchworth, are engaged in the production of press tools, jigs, and a wide variety of moulds. These moulds, it may be noted, are used chiefly for the production of rubber sealing strip of the type fitted to motor car doors. Since the company was established in 1946 it has steadily built up a connection with the hosiery industry, and a substantial part of the productive capacity of the works is reserved for the manufacture of metal forms used for shaping nylon stockings. F. W. H.

Automatic Production

(Continued from page 175)

fitting and removal of the burnishing barrel covers.

Where such methods are to be employed, it is obvious that the cost of equipping for the manufacture of a new product must continue to rise rapidly. Installations of this nature are becoming increasingly common, however, and automatic production is by no means confined to the U.S.A., as will have been evident from various articles on Continental practice which were published in MACHINERY last year. This progress will inevitably continue elsewhere, and so long as we attempt to implement a policy of restricting investment in productive equipment, our manufacturing methods generally must tend to lag further and further behind those of our competitors.

Inspector of Factories Report, 1956

In the Annual Report of the Chief Inspector of Factories for the year 1956,* reference is made to the rapid growth in the use of radio-active materials in the form of sealed sources. The most extensive application is for the gamma-radiography of castings and welds. Isotopes mainly employed are iridium 192, cobalt 60, and caesium 137, and the last-named is finding increasing favour because of its long half-life of 33 years. For gauging the thickness of steel strip, wide use is made of isotopes such as strontium 90 and thallium 204, which are firmly bonded in solid solution within an aluminium alloy foil, the latter being then rolled between two thin foils of pure aluminium alloy. Preparation of foil sources has been transferred from Harwell to the Radiochemical Centre at Amersham. To bring the use of radio-active materials in sealed sources under more detailed control, draft regulations have now been

* Cmd. 329 H.M. Stationery Office, Price 9s. 6d. net.

published, which are complementary to those already in existence for luminizing.

In reviewing progress in safety equipment, attention is drawn to the unsatisfactory standards of some Continental machinery in respect of guarding, and British automatic monitoring equipment, which has been developed for use in conjunction with photo-electric guards on presses, is commended.

The report states that during the year 1956 a total of 184,098 accidents of all kinds, involving injury, was notified, also 687 more which were fatal. For the previous year, the corresponding numbers were 187,700 and 703, and the accident rate for 1956 was the lowest yet recorded. Fifty-eight accidents are reported as having occurred in connection with automatic equipment, and a number of examples are given which draw attention to the main risk anticipated with the coming of automation, namely unexpected starting. One such accident occurred on an automatic foundry moulding machine, which, on account of a fault, was being operated on a hand cycle, and the operator was injured when automatic working was unexpectedly resumed. In another instance, a non-ferrous coil handling plant was functioning in a faulty manner because of a worn stop. A worker attempted to release the coil, which had jammed, but his action coincided with the next sequence of the equipment, and his foot was trapped. In this connection, it is suggested that, in addition to the fitting of fencing, control units should be so arranged as to stop equipment in the event of incorrect operation at any stage in a cycle.

Broom & Wade, Ltd.

A tour of the works of Broom & Wade, Ltd., at High Wycombe, Bucks., was recently organized, during which an opportunity was afforded of observing all the stages involved in the manufacture of the company's portable and stationary compressor units, and the newly installed equipment for producing a range of Aro-Broomwade portable pneumatic tools.

The company has been producing the reciprocating-type of sleeve-valve compressor for many years, and for this unit there is still a sustained demand, but the latest portable compressors are of the rotary type. This design offers a better size-output ratio than the reciprocating machine, and the company is experiencing a growing demand for such compressors from the North American continent. Both reciprocating and rotary machines are in continuous production at the moment, but it is anticipated that the rotary type

of machine will eventually supersede the sleeve-valve compressor. The firm received a visit from the Canadian Trade Mission which toured the U.K. recently, and a large export order for Canada is being negotiated at the present time.

As a result of a recently concluded agreement with Aro Pneumatic, U.S.A., Broom & Wade are already producing a range of portable pneumatic tools, which will be marketed under the name of Aro-Broomwade. A new building has been erected for the production of these tools, and the range includes screw-drivers, nut-runners and pistol-grip drills. Each unit is powered by a built-in, rotary vane, air motor, and the tools are light and easy to handle. An adjustable spring-balanced suspension is also available, for use with tools which require to be positioned above an assembly bench.

Demonstrations were given of representative types of portable tools, also of the Aro-Broomwade Mini-hoist. This hoist can be carried easily by one man, and will raise a load of 10 cwt. at a rate of 25 ft. per min.

Letters to the Editor

[The Editor does not hold himself responsible for the views expressed by his correspondents.]

The Millionth of an Inch

[To the Editor of MACHINERY]

SIR,—Dr. J. C. Evans, of the National Physical Laboratory, suggests the general adoption of the term micro-inch for one millionth of an inch. In our work of servicing slip gauges we are continually dealing in hundred-thousandths and millionths of an inch, and I am very interested in his proposal.

To start with, the problem is simplified if we follow the recommendations of British Standard 1957:1953, The Presentation of Numerical Values, pages 14 and 15. It is advocated that the two units should be written 0.000 01" and 0.000 001" rather than 0.00001" and 0.000001". The space splits up the figure and saves counting the noughts. It is equivalent to the comma in 100,000, which one never sees written 100000. The reason for using the space instead of a comma in a decimal is to avoid possible confusion with the decimal point.

It is also of assistance to write 0.000 001" instead of 0.000 001 in., because the word "in" has a second common meaning, and because the full-stop tends to check the reader, giving him the momentary impression that he has reached the end of a sentence. In theory " could be confused with quotation marks, but not, I think, in practice.

The problem, thus reduced, nevertheless remains, and I, personally, welcome Dr. Evans' proposal to use the term micro-inch.

I cannot say the same for the abbreviation μ in. partly because the letter μ does not appear on the standard typewriter, and more generally because we should express ourselves in English wherever possible, rather than in Greek. Physicists use so many symbols that they have had to adopt the whole of the Greek alphabet. Engineers need not copy them.

Practically all the abbreviations of units which have survived in common use have only two letters. Apparently people reject anything longer. If we accept this limitation, then in the present case one letter must stand for millionth, and this should be the English m rather than the Greek μ , and one must stand for inch, and here we may use the sign ". Our abbreviation then becomes m, and we write 0.000 001" as 1m".

ALAN BROWNE

Blackdown Mill, near Leamington

T. S. Harrison Jubilee Dinner

The chairman and directors of T. S. Harrison & Sons, Ltd., Union Works, Heckmondwike, Yorks., recently entertained their employees to a dinner at the Prospect Hall, Cleckheaton, to celebrate the company's diamond jubilee. Following the loyal toast, proposed by the chairman, Mr. A. G. B. Owen, the toast of "The Company" was proposed by Mr. G. W. Nash, managing director of Buck & Hickman, Ltd., supported by Mr. F. T. Sutcliffe, the firm's first apprentice, and Mr. A. G. B. Owen responded. Mr. B. E. Cash, managing director, introduced Mr. B. White, who was presented by the chairman with a gold wrist watch for 25 years' service, and Mr. T. S. Harrison (founder), with 60 years' service, received a clock. Both recipients expressed their appreciation and thanks.

Coming Events

INSTITUTION OF ENGINEERING INSPECTION. *West of Scotland Branch.* January 29, at 7.30 p.m., at the St. Enoch Hotel, Glasgow; paper, illustrated with sound film, on "Computer Control of Machine Tools," by A. A. Lodge.

INSTITUTION OF ELECTRICAL ENGINEERS. *North-Western Supply Group.* January 28, at 6.15 p.m., at the Engineers' Club, Albert Square, Manchester; paper on "The Digital Computer Applied to the Design of Large Power Transformers," by W. A. Sharpley and J. V. Oldfield, B.Sc.(Eng.)

INSTITUTION OF MECHANICAL ENGINEERS. *Eastern Branch.* January 28, at 7.30 p.m., at the Dujon Restaurant, Bedford; paper on "Design and Production of Agricultural Machinery," by H. H. Dawson.

INSTITUTION OF PRODUCTION ENGINEERS. *Shrewsbury Section.* January 29, at 7.30 p.m., at the Technical College,

Shrewsbury; lecture on "High-speed Press Work," by J. A. Grainger. *Lincoln Section.* January 30, at 7.30 p.m., at the Ruston Club, Lincoln; lecture on "The Centre-spinning Process as Applied to the Manufacture of High-duty Components," by A. E. Thornton.

G.T.M.A. Officers

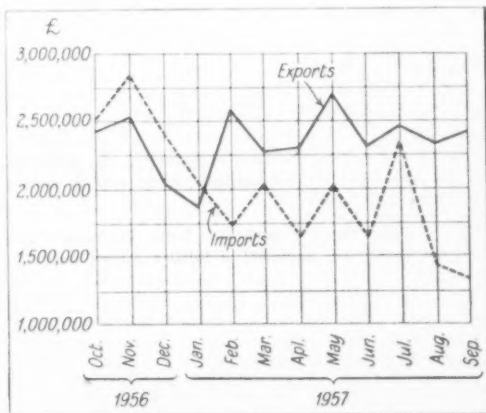
The following officers of the Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1, have been re-elected for the year 1958. President, Mr. F. W. Halliwell, C.B.E., M.I.Mech.E., M.I.Prod.E.; Deputy President, Sir Stanley Harley, B.Sc., M.I.Mech.E., M.I.Prod.E.; Vice-Presidents, Mr. A. L. Dennison, M.I.Prod.E., Mr. H. S. Holden, M.I.Prod.E., and Mr. T. Ratcliffe, M.I.Prod.E.; Chairman, Mr. L. E. Van Moppes; Vice-Chairmen, Mr. G. P. Barrott, M.I.Prod.E., and Mr. R. Kirchner, M.I.Mech.E., M.I.Prod.E.; and Hon. Treasurer, Mr. H. G. Carmichael Wilson.

Obituary

MR. J. L. DANIELS, chairman and managing director of T. H. & J. Daniels, Ltd., Lightpill Iron Works, Stroud, Glos., died on January 9, at the age of 50, as a result of injuries received in a motor car accident near Derby. He was educated at Wycliffe College and Birmingham University where he obtained a B.Sc. degree, and joined the family business in 1930. A hard and enthusiastic worker, Mr. Daniels played a vital part in the subsequent expansion and development of the company, and saw the number of employees increase from 135 to 600.

Machine Tool Exports and Imports

The accompanying graph shows the monthly fluctuation in exports and imports of machine tools during the year ended September, 1957.



Industrial Notes

THE SKEFKO BALL BEARING CO., LTD., Luton, report that the number of employees who have completed 25 years' service with the company has now reached 500, of whom 350 are still at work.

BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough, have received an order from the Cape Town Corporation, South Africa, for three 40,000 kVA and two 30,000 kVA transformers.

CENTEC MACHINE TOOLS, LTD., is the new title which has been adopted by the company formerly known as Central Tool & Equipment Co., Ltd. The address (Centec Works, Hemel Hempstead, Herts.) remains the same, and there will be no change in the management or products.

AT THE PRODUCTION EXHIBITION, which is to be held at Olympia from May 12 to 21, special sites will be provided to enable smaller firms, with fewer than 250 employees, to demonstrate methods or techniques at reasonable cost. Full particulars can be obtained from The Production Exhibition, 32 Millbank, London, S.W.1.

ENGINEERING AND ALLIED EMPLOYERS' WEST OF ENGLAND ASSOCIATION, Department of Work Study and Staff Training, Brunel House, St. George's Road, Bristol 1. Particulars of courses in work study and supervisory management to be held during 1958, also certain specialist courses, can be obtained from the above address.

B. ELLIOTT & CO., LTD., will hold an exhibition of machine tools and equipment at Princes Hall, Bingley Hall, Broad Street, Birmingham, from February 17 to 22. More than 60 machines will be demonstrated under power, and a range of engineering equipment, including some recently-introduced items, will also be on view.

THE SCIENTIFIC INSTRUMENT MANUFACTURERS' ASSOCIATION OF GREAT BRITAIN, 20 Queen Anne Street, London, W.1, have announced that their next Convention will be held at the Majestic Hotel, Harrogate, from November 6 to 9, 1958. This will be the seventh annual Convention, and for the first time it will be held in the north, having previously been staged at Eastbourne.

NORTH GLOUCESTERSHIRE INDUSTRIAL EDUCATION COUNCIL, 8 Lansdown Place, Cheltenham, will hold a conference on October 21 and 22 on the theme "what the schools can do." One of the matters considered will be the careers available to women in industry. In addition, an exhibition illustrating industrial careers will be staged from October 21 to 26.

THE UNITED STEEL COMPANIES, LTD., 17 Westbourne Road, Sheffield, 10, achieved a further record for steel production in 1957, for the sixth successive year. Output totalled 2,903,809 ingot tons, as compared with 2,685,836 ingot tons in 1956. Pig iron production, at 1,813,044 tons, was also a record for the company. The corresponding figure for 1956 was 1,586,290 tons.

PLANNER WITH HEID TRACER UNIT.—IN MACHINERY, 92/33—3/1/58 was published a description of a Butler

36-in. openside crank planer equipped with a Heid electric copying unit. It should be pointed out in this connection that Newman Industries, Ltd., Yate, Bristol, are sole representatives in this country for Heid products which include lathes, multi-disc electromagnetic clutches, planer drives, and tracer controlled units.

STANLEY WORKS (GT. BRITAIN), LTD. This company's new hammer factory at Ecclehall, Sheffield, was recently opened. Standing in a 5-acre site, the building has an area of 30,000 sq. ft., and includes a machine shop and forge. Initially, production will be confined to the No. 40 and No. 90 series of claw hammers. It is anticipated that engineers' hammers will be available by the middle of the year, and all-steel claw hammers by 1959.

PITTER GAUGE & TOOL CO., LTD., Market Street, London, S.E.18.—The company's long service dinner, which was held recently at the Bull's Head Hotel, Chislehurst, was attended by 40 long service employees, and three who are now retired on pension. Sir Stanley J. Harley, B.Sc., M.I.Mech.E., chairman, proposed the toast of "Old Associates" and Mr. A. Hammond responded. "The Guests" was proposed by Mr. J. C. Brown, a director of the company, and Mr. T. N. Ritchie replied.

PREMIER COLLOID MILLS, LTD., in association with their northern agents, O. O. Robinson (Leeds), Ltd., have recently opened a laboratory at Glebe House, Hollin Lane, Leeds, 16. The company produces a range of precision mixers and colloid mills, and the facilities of the laboratory are available to firms who wish to test their materials on these machines. In addition, demonstrations and technical advice can be given. Similar services are offered by the main laboratory at Walton-on-Thames.

LAURENCE, SCOTT & ELECTROMOTORS, LTD., Gothic Works, Norwich, will show a motor of exceptional size at the forthcoming Electrical Engineers Exhibition at Earls Court. Because of its weight and dimensions, the motor will be displayed on a trailer in the forecourt. This 860/57-h.p., 790/316 r.p.m. motor is to be employed for driving the cooling fan of a 100-MW set at Willington power station. It weighs 17 tons, and is about 14 ft. long, 9 ft. wide, and 12 ft. high.

IBM UNITED KINGDOM, LTD.—Plans have been approved by the President of the Board of Trade which will involve doubling the size of the company's factory at Spango Valley, Greenock. This factory was opened in 1954. The company has stated that the expansion is necessitated by the growing demand, from both the home and export markets, for data processing machines and electric typewriters. When the factory has been extended it is anticipated that several hundred additional employees will be required.

FIELDEN ELECTRONICS, LTD., Wythenshawe, Manchester, have added a new level controller to their Tektor range. Known as the Major, the unit is operated by the capacity method and can be used for automatically con-

trolling the level of powdered and granular materials in hoppers, for example. It has a sensitivity exceeding 1.0pF, which is stated to be unaffected by fluctuations of ± 10 per cent in the supply voltage, or by changes in the ambient temperature from -20 to $+50$ deg. C.

BECKMAN INSTRUMENTS, LTD., the new British subsidiary of Beckman Instruments Inc., U.S.A., hope to start production in Scotland in the near future. Their new factory at Glenrothes, Fife, is now well advanced and will soon be ready for occupation. The company will concentrate at first on the manufacture of potentiometers, and the range of products will later be extended. Very stable atmospheric conditions will be provided throughout the factory to meet the requirements of the work to be undertaken.

VENESTA, LTD., Vinty House, Queen Street Place, London, E.C.4, report that as a result of the application of thermal insulation in the form of gypsum plasterboard laminated with aluminium foil, important economies were achieved in the heating of a large building. Measuring 540 by 360 ft., this typical factory building is divided in 18 bays, each 30 ft. wide. The plasterboard was applied to the undersides of the south slopes of the roof trusses, and enabled the average weekly consumption of fuel oil for heating to be reduced from 9,510 gal to 7,547 gal.

A CENTENARY LECTURE—"Siemens Brothers 1858-1958"—100 Years of Electrical Engineering—is to be given by Dr. J. N. Aldington, B.Sc., F.R.I.C., F.Inst.P., M.I.E.E., F.I.E.S., chairman and managing director of Siemens Brothers, in the Central Hall, Westminster, at 6.30 p.m. on March 5. Lord Chandos, chairman of Associated Electrical Industries, Ltd., will be in the chair. Admission will be by ticket only, and application should be made to the Centenary Organizer, Room 111, Siemens Edison Swan, Ltd., Caxton House, Westminster, S.W.1.

TAREX EXHIBITION AND DEMONSTRATION.—Tarex (England), Ltd., 22 Buckingham Gate, London, S.W.1, are to hold an exhibition at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, from March 3 to 7, inclusive. The recently-developed system for the production of workpieces in small batches, on Tarex single-spindle turret-type automatics, fitted with hydraulic copy-turning attachments, will be demonstrated. It is intended to illustrate the application of the system by re-setting a Tarex machine, from the production of one component to another, at least twice each day.

THE MORGAN CRUCIBLE CO., LTD., Battersea Church Road, London, S.W.11, have carried out extensive trials in their test foundry and have found that with the Birlec-Morgan electric die casting furnace, aluminium can be allowed to solidify and be re-melted in both Salamander Super and Suprex basins, without damaging them. The only precaution necessary is to ensure that the charge is completely molten and to avoid adding any solid metal just before switching off. A time-switch is now fitted as standard, so that metal which has solidified can be automatically brought to the required temperature at starting time the following morning.

NOVEMBER OUTPUT OF MOTOR CARS.—The British motor-car industry produced cars in November at the record weekly rate of 20,991. A total of 83,965 for the month

brought the figure for the first 11 months of the year to 769,960, which was 113,000 more than for the corresponding period of 1956. Cars exported in November numbered 41,081, with a total value of £15,184,991, and both these figures represented records for the month, while the value total was a record for any month. During the first 11 months of 1957 exports numbered 389,696, and this total may be compared with 398,302 for 12 months in the previous record year of 1955. The U.S.A. was the best export market in November with 10,230 cars, which brought the total for 11 months to 85,554, compared with only 34,599 in the same period of 1956.

DOMINION BRIDGE CO., LTD., Montreal, Quebec, Canada, recently celebrated the 75th anniversary of the founding of the company at Lachine, Quebec. In this connection a striking illustrated brochure has been issued which outlines the history of the business and makes reference to some of the major achievements. In 1900, some 90 per cent of the work undertaken was concerned with bridges. Today, however, bridge construction represents a comparatively small proportion of the annual output. Apart from supplying the steel frameworks for structures of all kinds, the company designs and builds gate equipment for hydro-electric power schemes, cranes, and other handling equipment; large vessels and other equipment for the pulp and paper, chemical, oil, and mining industries; and a wide range of boilers. It also maintains 11 steel warehouses, and operates a steel mill.

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24/1,58

Personal

MR. JOHN LOXHAM has been appointed to the Chair of Aircraft Economics and Production at The College of Aeronautics, and will take up this post on April 1.

MR. R. Y. PARRY has been appointed technical manager, and Mr. J. S. EPPSTEIN, B.Sc. (Eng.), A.C.G.I., chief engineer of Isotope Developments, Ltd., Beenham Grange, Aldermaston Wharf, Nr. Reading, Berks.

MR. C. W. M. PHILLIPS, A.M.I.E.E., F.I.E.S., has resigned his position as manager, lighting sales, A.E.I. Lamp & Lighting Co., Ltd., to join Britannia Engineering Co., Ltd., 28 Ashton Road, Luton, as managing director.

MR. VINCENT FLYNN has been appointed Scottish sales engineer for The Midland Heating & Ventilation Co., Ltd., Bedford Road, Birmingham, 11. He will operate from 16 Egilsay Crescent, Glasgow, N.2 (telephone number, Bishopbriggs 2667).

MR. H. J. LORANT has resigned from the position of managing director and from the board of Lorant & Co., Ltd., 98-100 Croydon Road, London, S.E.20. Mr. S. J. Harris is now chairman and managing director, and Mr. F. K. Derrick has been appointed deputy managing director.

MR. A. O. AHLQUIST, M.A., A.M.I.Mech.E., has been appointed sales manager of the Mechanical Department of Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17. He succeeds Mr. H. Lawson-Jones who has been transferred to "sales management" and will act in an advisory capacity.

MR. K. G. LAMPSON, LT.-COL. P. F. BENTON JONES and LT.-COMMANDER G. W. WELLS have been appointed directors of Steel, Peech & Tozer and Workington Iron & Steel Co., two branches of The United Steel Companies, Ltd., 17 Westbourne Road, Sheffield, 10. Lt.-Col. Benton Jones has also been appointed a director of the Beckermitt Mining Co., Ltd.

MR. D. W. LINDSAY, A.M.I.Prod.E., is succeeding Mr. D. C. L. WELCH as technical representative for Soag Machine Tools, Ltd., for Lancashire and Cheshire. He has been with the company since 1947 and was originally employed on the production side. His knowledge of all types of machine tools is wide. Mr. Welch, who has represented Soag in this area since 1938, will in future concentrate on Yorkshire, Darlington, Nottinghamshire and Lincolnshire.

MR. J. A. G. WILLIAMS, M.Sc., A.M.I.Mech.E., A.F.R.Ae.S., A.B.P.S., has been appointed principal of the College of Aeronautical and Automobile Engineering, Chelsea. Formerly head of the engineering section of the National Coal Board's Industrial Training Branch, Mr. Williams has been concerned with technological education since 1939, when he became a lecturer in aerodynamics at the de Havilland Technical School.

SIR WILLIAM WALLACE, C.B.E., LL.D., F.R.S.E., M.I.Mech.E., M.I.N.A., has retired from the position of managing director of Brown Brothers & Co., Ltd., Rosebank Iron Works, Edinburgh, 7, after the completion of 40 years' service in this capacity. He will continue to serve as chairman of the board. MR. C. C. MITCHELL, O.B.E., B.Sc., M.I.Mech.E., A.F.R.Ae.S., has been appointed managing director of the company.

Scrap Metals

†LONDON.—†Prices per ton for non-ferrous scrap metals free from iron are as follows:—clean copper wire, untinned and free from lead and solder, £140; clean heavy copper, untinned and free from lead and solder, £132; second grade copper wire, £127; clean light copper, £123; brazing copper, £110; gunmetal, £120; brass mixed, £78; lead, net, £57; zinc, £30; cast aluminium, £89; old rolled aluminium, £122; battery lead, £30; unsweated brass radiators, £65; hollow pewter, £495; black pewter, £365.

MIDLANDS.—There has been little or no improvement in the allocations from local steelworks and blast furnaces for all grades of scrap. Merchants have had to look further afield for markets and there is a definite surplus of scrap in their yards.

The greatest difficulty is experienced in clearing "bushy" turnings. Limited quantities can be delivered by road locally, but none of this material is being consigned by rail to local blast furnaces and accumulations at factories are therefore not being cleared as efficiently and quickly as usual. Output of chipped turnings is maintained and large tonnages are now moving from the Midlands to the Sheffield and Derbyshire areas.

Heavy steel allocations are insufficient to clear supplies from merchants' yards, and both No. 2 furnace size steel and hydraulically compressed No. 4 bundles are being stocked in hope of an improvement in demand.

Light scrap is plentiful and prices have fallen as merchants cannot find space to stock further tonnages. Restrictions on delivery of destructor bales to many consumers have caused merchants to limit their purchases of light destructor scrap.

Foundry trading is rather more healthy, and there is a steady business in short heavy steel and cast-iron scrap. It appears that the improved allocations will be met without difficulty, because merchants have accumulated good stocks of all grades of cast iron in their yards during the past few months.

Parcels of high-speed steel scrap are not bringing very good prices as demand is weak, and a further fall may be imminent.

Maximum prices are still in force in respect of sales to steelworks and blast furnaces, but offers by merchants are lower than normal because material must be stored, or forwarded over greater distances to less favourable markets.

Current maximum control prices, delivered consumers' works, are now: *Heavy steel No. 1, 217s. 6d.; *heavy steel No. 2, 196s.; *heavy steel No. 4, 207s. 6d.; *heavy steel No. 5, 195s. 6d.; light iron No. 8, 149s.; short turnings No. 9 (free from alloy), 167s. 3d.; light steel No. 11, 164s. 3d.; bushy turnings, 117s.; short alloy turnings, 160s. 9d.; short steel No. 2, 233s. 3d.; machinery cast, 233s.

Prices may be increased up to 2s. 6d. per ton according to quantities tendered over a given period.

* For use by Round Oak Steelworks, Brierley Hill, increase by 1s. 6d. per ton.

† George Cohen, Sons & Co., Ltd., Commercial Road, E.14.

‡ Subject to market fluctuations.

Books Received

SELECTED BRITISH TECHNICAL JOURNALS. Federation of British Industries, 21 Tothill Street, S.W.1. [Price 2s.]

This annotated list is intended primarily for the use of former FBI overseas scholars and other overseas engineers trained in Britain. It is, however, also available for purchase in this country.

SOLDERING ALUMINIUM. The Aluminium Development Association, 33 Grosvenor Street, London, W.1. 35 pp. [Price 2s.]

Machine Tool Share Market

Stock markets, which had been dull in rather subdued conditions, gradually developed a hardening tendency, and the past week ended on a steady note, but with activity at a low level.

After initial easiness, the gilt-edged section rallied, and at the close, higher levels were recorded for British Funds, and Home Corporation and Commonwealth loans.

In industrial share markets conditions were mixed, with buying interest moderate and selective. Early dullness was followed by generally brighter conditions, but apart from a few individual features, price changes on balance were small and irregular.

Among machine tool issues, Edgar Allen advanced 3d.

Issued as information bulletin No. 23, this booklet is of the high standard which is characteristic of the Association's publications. Sections are devoted to the basic principles of soldering this metal; aluminium and its alloys suitable for soldering; solders; fluxes; soldering methods and equipment; finishing soldered components; soldering aluminium to other metals; properties and characteristics of soldered joints; and choice of solder and soldering method. The text is accompanied by excellent half-tone illustrations and diagrams, and there is a table giving information on representative solders for aluminium.

EDGAR ALLEN & CO., LTD.—Interim dividend 5 per cent.

GREENWOOD & BATLEY.—Interim dividend 5 per cent.

COMPANY		Demon.	Middle Price	COMPANY		Demon.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	1/-	Harper (John) & Co., Ltd.	Ord.	5/-	14/3
Armstrong, Stevens & Son, Ltd.	Ord.	5/-	8/-	"	4½% Red.	£1	12/9
Allen (Edgar) & Co., Ltd.	Ord.	£1	30/-	"	Cum. Prf.		
"	5% Prf.	£1	15/-*	Herbert (Alfred), Ltd.	Ord.	£1	57/6
Arnott & Harrison, Ltd.	Ord.	4/-	13/9	Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	11/-
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	18/3	"	"B" Ord.	5/-	10/-
"	6% Cum. Prf.	£1	17/9	"	Ord.	5/-	23/9
Birmingham Small Arms Co., Ltd.	Ord.	£1	26/-	"	7% Cum. Prf.	5/-	5/-
"	5% Cum.	£1	15/-	Kayser, Ellison & Co., Ltd.	Ord.	£1	54/-
"	"A" Prf.			"	6% Cum. Prf.	£1	18/3
"	6% Cum.	£1	17/6	Kendall & Gent, Ltd.	Ord.	5/-	7/9
"	"B" Prf.			"	Ord.	5/-	6/-
"	4% 1st Mort. Deb.	Stk.	84½	Kerry's (Gt. Britain), Ltd.	Ord.	5/-	10/9
British Oxygen Co., Ltd.	Ord.	£1	30/7½	Kitchen & Wade, Ltd.	Ord.	4/-	10/9
"	6½% Cum. Prf.	£1	20/6	Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	5/6	Massey, B. & S., Ltd.	Ord.	5/-	7/3
Broom & Wade, Ltd.	Ord.	5/-	10/6	Modern Engineering Machine Tools, Ltd.	Ord.	5/-	10/9
"	6% Cum. Prf.	£1	17/9	Newall Engineering Co., Ltd.	Ord.	2/-	5/-
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	12/6	Newman Industries, Ltd.	Ord.	2/-	2/9
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/6	"	6% Prf. Ord.	5/-	5/6
Butler Machine Tool Co., Ltd.	Ord.	5/-	9/9	Noble & Lund, Ltd.	Ord.	2/-	4/9
"	5% Cum. Prf.	£1	15/9	Osborn (Samuel) & Co., Ltd.	Ord.	5/-	37/-
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red.	£1	13/9	"	5½% Cum. Prf.	£1	25/6
"	Cum. Prf.			Pratt (F.) & Co., Ltd.	Ord.	5/-	19/4½d
Churchill (Charles) & Co., Ltd.	Ord.	2/-	4/10½	Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	4/9
"	6% Cum. Prf.	£1	26/3½	Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	35/-
Churchill Machine Tool Co., Ltd.	Ord.	5/-	17/7½	Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/6
"	6% Cum. Prf.	£1	18/9	Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	35/-
Clarkson (Engers), Ltd.	Ord.	5/-	10/6	"	5% Cum. Prf.	£1	15/-
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/6	"	Ord.	5/-	5/3
"	4½% Cum. Prf.	£1	14/3	Stedall & Co., Ltd.	Ord.	5/-	8/-
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	15/6	Tap & Die Corporation, Ltd.	Ord.	5/-	8/-
"	5% Cum.	£1	13/9	"	4½% Deb.	Stk.	82/-
"	Red. Prf.			"	1961-1977		
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6	Wadkin, Ltd.	Ord.	10/-	19/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	5/6	"	Ord.	£1	73/1½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/-	Ward (Thos. W.), Ltd.	Ord.	£1	15/-
"	4½% Red.	£1	13/9	"	5% Cum.	£1	23/9
"	Cum. Prf.			"	1st Prf.		
Export Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/9	"	5% Cum.	£1	23/9
"				"	2nd Prf.		
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/-	Willson Lathes, Ltd.	Ord.	1/-	2/4½
Greenwood & Batley, Ltd.	Ord.	£1	46/10½d				

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error.

* Sheffield price.

† Birmingham price.

PRICES OF MATERIALS

All prices per ton except
where otherwise stated.

Pig-Iron

Foundry and Forge
No. 3, Class 2

Middlesbrough zone Birmingham	£21 6 0
Phos. 0.1 to 0.75% Birmingham	£20 18 3
Scottish Foundry Grangemouth	£23 17 0

Hæmatite

English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0
Welsh	£25 6 6

Steel Products

Medium plates	£46 1 6
Mild steel plates, ordinary*	£42 12 0
Boiler plates*	£45 2 0
†Flat bars 5 in. wide and under ‡Round bars under 3 in.	£40 8 0
Billets, rolling quality, soft U.T.	£33 1 6

Phosphor Bronze

Ingots (288) (A.I.D.) d/d	£248 0 0
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Copper

Cash (mean)	£169 5 0
Cold rolled and hot rolled Sheets 4 ft. by 2 ft. by 10 SWG	£238 5 0—£238 10 0
Rods $\frac{1}{2}$ in. to $\frac{3}{4}$ in. diam.	£257 5 0
Tubes, $\frac{1}{2}$ in. bore by 10 SWG, ton lots, per lb.	2s. 5½d.
Wire rod, black, hot-rolled ($\frac{1}{2}$ – $\frac{3}{4}$ in.) English	£186 12 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean)	£61 3 9
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Brass

Tubes, solid draw, per lb.	1s. 5d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£205 15 0—£208 10 0
Rods, $\frac{1}{2}$ in. diam. (59 per cent copper)	1s. 7½d.

Yellow Metal

Condenser plates, per ton	£144 0 0
Rods, per lb.	1s. 8½d.

Aluminium

Ingots min. 99.5 per cent Canadian d/d	£197 0 0
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Lead

Refined, minimum 99.97 per cent purity, current month (mean)	£72 12 6
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Tinplates

‡U.K. Home trade: Handmill f.o.t. makers' works	£3 12 2½
Cold reduced, f.o.t. makers' works	£3 7 10½
U.K. Export: Hot rolled basis, f.o.t. works' port	74s. 0d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	76s. 0d.—76s. 6d.

Gunmetal

Ingots, 85.5.5.5. ex works	£164 0 0
*N.E. Coast, N. Joint Area, Central Scottish Zone.	
†U.T. soft basic.	
*Official maximum price, after allowing for adjustments for increase in price of tin.	

MAKERS' PRICES

Hexagon Steel Bars¹

Sizes in inches from 0.7049 up to 2.21 and 2.41 w/f, ex works basis	£43 4 6
Free cutting black	£47 10 0

Reeled Steel Bars¹

Single-reeled $\frac{1}{2}$ in. upwards, f.o.t. works († usual extra for sizes)	£43 17 6
Free cutting	£48 2 6

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.	
Molybdenum "66"	5s. 10½d.
Molybdenum "46"	5s. 8½d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1½d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4.75/5.25 per cent molybdenum + 6.0/6.75 per cent tungsten + 1.75/2.05 per cent vanadium (S-6-2)	6s. 0½d.

Precision-ground, High-speed Free-turning Brass Rod²

$\frac{1}{8}$ -in. dia. \pm 0.00025-in. 2-ton lots, per lb.	2s. 3½d.
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Grey Iron Rod

Die Cast³ in random lengths
18 in. to 24 in. rough machined
 $\frac{1}{2}$ -in. above listed size. Extra
for definite lengths, for
hardenable alloy iron, and
for orders of less than £50.
Discounts for orders over
£150.

	Per cwt. net.	Mark I	Mark III
$\frac{3}{4}$ or $\frac{7}{8}$ in.	255s. 6d.	318s. 10d.	
1 or $1\frac{1}{8}$ in.	204s. 4d.	251s. 10d.	
$1\frac{1}{2}$ to $1\frac{3}{4}$ in.	143s. 0d.	171s. 2d.	
$1\frac{7}{8}$ to 2 in.	106s. 2d.	125s. 11d.	
2½ to 3½ in.	91s. 6d.	106s. 4d.	
3½ to 12 in.	86s. 6d.	99s. 2d.	

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0.010 to 0.020 in., prices as quoted for die cast bars	
6-ft. lengths	$\frac{3}{4}$ or $\frac{7}{8}$ in. 245s. 4d.
centreless ground	1 or $1\frac{1}{8}$ in. 196s. 4d.
+ 0.010 in. Extra	
for hardenable	$1\frac{1}{2}$ to $1\frac{3}{4}$ in. 137s. 10d.
alloy iron ⁴	$1\frac{7}{8}$ to 2 in. 106s. 2d.
Per cwt. net.	2½ to 3 in. 91s. 6d.

Stellite⁵

Welding Rods (plain)	
$\frac{1}{2}$ in. dia. per lb.	30s. 0d.
Toolbits	
$\frac{1}{2}$ in. sq. x 4 in., each	22s. 3d.

Precision-ground Mild Steel²

1-in. dia. \pm 0.00025-in.	121s. 6d.
4-ton lots, per cwt.	

¹ Colvilles, Ltd., Glasgow, and 17 Grosvenor
Street, London, W.1. ² Pratt, Lavick & Co.,
Ltd., Chester. ³ Sheepbridge Alloy Castings,
Ltd., Sutton-in-Ashfield. ⁴ "Floccast," Harold
Andrews Sheepbridge, Ltd., Malesowen.
⁵ Daloro Stellite, Ltd., Highlands Road,
Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK*

Free Cutting Steel

Bright cold drawn: (Usaspeed) over $1\frac{1}{2}$ to 2 in.	£59 17 6
Lead bearing (Usaled)	£63 17 6
Precision ground, $1\frac{1}{2}$ in.	£81 12 6

Bright Drawn

M.S. bars (M.M.C.) over $1\frac{1}{2}$ in. to 2 in.	£55 8 6
Square edge flats (Usafiat)	£72 5 0
M.S. angles (Usaspeed)	£99 10 0
Casehardening (EN) (Usacase) over $1\frac{1}{2}$ in. to 2 in.	£63 14 6
M.S. bars (EN3B) (Usamild) over $1\frac{1}{2}$ to 2 in.	£57 8 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspeed 202) over $1\frac{1}{2}$ to 2 in.	£71 14 0
35/45 ton tensile (EN6) (Usen) over 1 to $1\frac{1}{2}$ in.	£65 2 6
0.4 Carbon Normalised (Usaspeed "40") over $1\frac{1}{2}$ in. to 2 in.	£67 4 6
Carbon manganese steel to Specifi- cation EN.16.T (Usaspeed 5565), per ton	£127 10 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usas-
peed). List prices less 5 per cent.

Oil Hardening Cast Steel

Non-shrink (Usaspeed N.S.O.H.) $\frac{1}{2}$ in. to $2\frac{1}{2}$ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspeed H.C.H.C.) $\frac{1}{2}$ -in. to $2\frac{1}{2}$ -in., per lb.	4s. 2d.

Silver Steel

(0.194-in. to $1\frac{1}{2}$ -in.) Genuine Stubs quality, per lb.	4s. 6d. less 27½%
M.M.C. quality, per lb.	2s. 5d. + 6½%
Boxes of 16 assorted sizes $\frac{1}{16}$ -in. to $\frac{3}{4}$ -in. dia.	7s. 6d.

Stainless Steel

K.E. 40 AM (Freecutting), per lb. 3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (288) } Prices on Lead bronze } application	
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High-speed Steel

18 per cent. tungsten. Prices on application. Toolholder bits:	
Usaspeed "Super"	} List price
"Supreme"	
Cobalt 10	

Shimstock

Steel assorted, per tin	3s. 6d.
Brass " " "	7s. 3d.

* Macraedy's Metal Co., Ltd., Pentonville
Road, N.1. Subject to confirmation by
London Office. Delivered free by van in
London area.